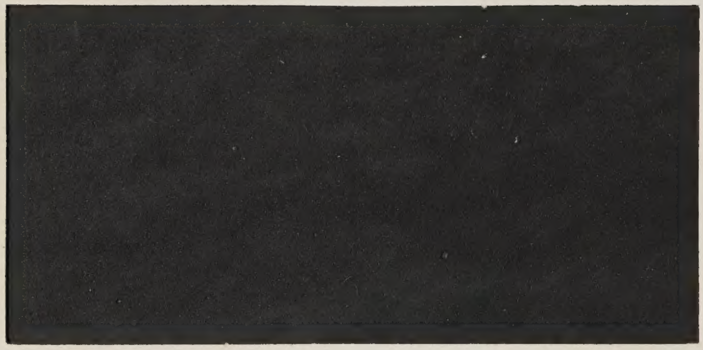
INSTRUCTION MANUAL

Panoramic*

PANADAPTOR

SINGER
INSTRUCTIONMENTATION



INSTRUCTION MANUAL

Panoramic*

PANADAPTOR

MODEL SA-3

TYPE T-2000NC

Gertsch*

EMPIRE*

Sensitive Research*

Panoramic*

SINGER

Precision electrical and electronic instruments for measurement

THE SINGER COMPANY • METRICS DIVISION

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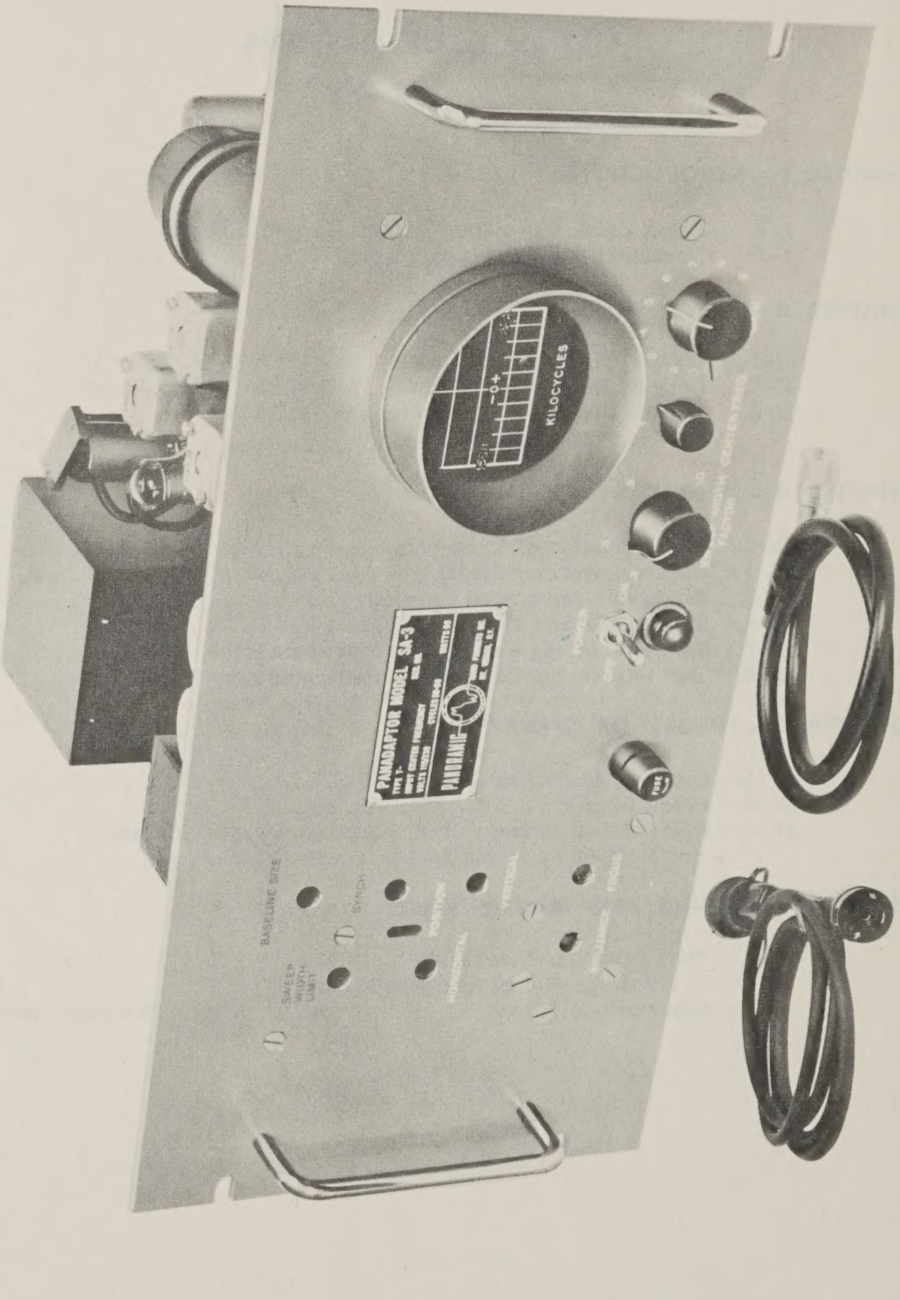


Figure I-1. Front View, Model SA-3, Type T-2000NC

SECTION I
INTRODUCTION

I-1. GENERAL

This Instruction Manual has been prepared to assist in the installation, operation, and maintenance of the Panoramic Panadaptor, Model SA-3, Type T-2000NC.

No attempt to operate the equipment should be made until the operator is thoroughly familiar with the information contained in CHAPTER III - OPERATION.

I-2. APPLICATIONS

The uses described below represent but a few of the many applications of the Panadaptor. Inquiries are invited regarding the application of these instruments to particular requirements.

The Panadaptor is invaluable for monitoring telemetry signals and observing adjacent telemetry channels for interference. It may be used for locating clear channels for interference-free transmission, or to effectively monitor transmitters for frequency drift. The Panadaptor is especially suitable for monitoring communication bands at airports and at communication centers for possible off-frequency transmissions. The appearance of such signals can be instantly detected, enabling quick tuning with a minimum chance of message loss. High resolution makes the Panadaptor ideal for detecting and analyzing interference caused by splatter, improper location of carrier-frequencies, spurious modulation, parasitics, etc. In universities and technical schools, the Panadaptor is extremely useful for its graphic indications of various r-f phenomena, thereby making such phenomena easily understandable and simple to remember.

I-3. EQUIPMENT SUPPLIED

Identification of the equipment covered by this Manual will be found on the nameplate on the front panel and on the patent label on the rear chassis apron. The following units constitute a complete equipment:

Description	Qty
Panadaptor, Model SA-3, Type T-2000NC . . .	1
R-f Input Cable, Pan Part W-3007	1
A-c Power Line Cord, Pan Part W3033	1

I-4. GENERAL DESCRIPTION

The Panadaptor is an automatic scanning receiver which permits visual analysis and identification of one or many radio-frequency signals at one time. Each signal within the band being scanned is displayed on a cathode-ray tube screen as a pip or a group of pips depending upon the nature of the signal. The "pip" amplitude and position along the calibrated horizontal axis are indicative of signal level and frequency, respectively.

The Panadaptor is designed to operate in conjunction with a companion receiver whose intermediate frequency is 30 mc. Interconnection is made between the output of the receiver converter and the INPUT of the Panadaptor.

In operation, the receiver is tuned to the center of the spectrum segment to be observed. The signal to which the receiver is tuned will appear at the center of the crt screen as a pip or group of pips depending upon its nature. All signals within a specified range above and below this center frequency will also be visible along the calibrated horizontal axis of the crt.

The extent of the band display above and below this center frequency, or sweep width, is adjustable from 2 megacycles (1.0 mc on each side) to "zero". Either locally or remotely generated signals may be observed. The limits of the frequency spectrum which may be covered by the Panadaptor are dependent upon the tuning range of the companion receiver.

The flatness of amplitude indication in the Panadaptor is the product of the receiver selectivity, as seen at the output of the converter, and the bandpass characteristic of the Panadaptor. Since the receiver selectivity will vary throughout the tuning range, the relative amplitudes of the signal deflections distributed across the crt screen may not correspond to the actual relative signal levels. As the receiver is tuned, all of the "pips" will move either to the left or to the right across the crt screen depending on the direction of tuning.

Image presentation in the Panadaptor is mainly a function of the image rejection capability of the companion receiver. Images, however, can be readily identified since the image deflections will

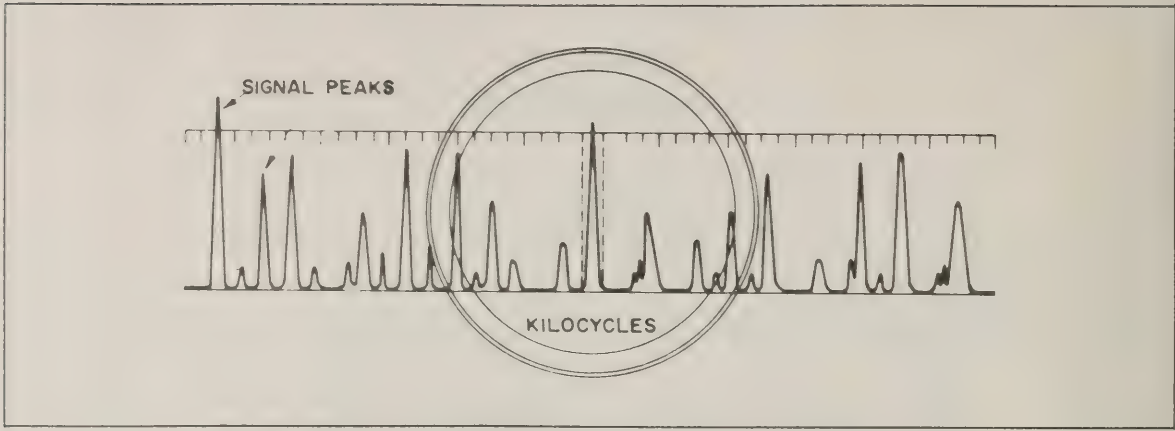


Figure I-2. Presentation of Radio Frequency Spectrum

move in a direction opposite to that of the regular signals as the companion receiver is tuned.

In Figure I-2, the entire strip represents a portion of the r-f spectrum. That portion within the circle represents the range visible on the crt screen. The pip in the center of the circle (within the dotted lines) is the indication of the signal to which the companion receiver is tuned. Each signal produces its own pip or group of pips which helps identify and analyze the signal.

FIRST: The positions of the pips along the horizontal baseline indicate the frequencies of the signals with respect to the center frequency. The horizontal axis of the screen is divided into ten parts. Each segment represents one tenth of the total sweep width. At maximum sweep width (3mc) each segment would therefore denote 300 kc. The frequency of the center signal may be read off the receiver tuning indicator.

SECOND: The height of the pips indicate the relative levels of the signals producing them. The height of each pip is proportional to the strength of the signal; strong signals produce high peaks, weak signals low peaks.

THIRD: The shape and behaviour of the pips reveal the character of the signal and the type of modulation, whether c-w, phone or pulse, etc. (See Paragraph III-2. INTERPRETATION OF SCREEN PRESENTATIONS.)

I-5. ELECTRICAL CHARACTERISTICS

MAXIMUM SWEEP
WIDTH . . . . 2 MC

INPUT CENTER
FREQUENCY (Required intermediate-frequency of receiver) . . . . 30 MC

RESOLUTION *
(At maximum sweepwidth) . . . . 20 kc
(At 20% of maximum sweepwidth) . . . . 16 kc

DIRECT SENSITIVITY . . . . . . 10 uv
(Maximum voltage at center frequency required for 1/4'' deflection

INPUT BANDPASS
CHARACTERISTIC 1:1
(Amplitude ratio of side peaks to center valley)

SWEEP RATE . . . . 30 cps, line-synchronized

VISUAL INDICATOR . . . . 3BP1A - 3 inch medium-persistance crt.

POWER SOURCE . . . . 115/230 volts, 50/60 cps

POWER CONSUMPTION . . . . . 65 watts

I-6. PHYSICAL CHARACTERISTICS

Weight:	43 lbs (in cabinet)
	36 lbs (without cabinet, suitable for rack mounting)
Dimensions:	See Outline Dimensional Drawings, Figures II-1 and II-2.

---

* Resolution is defined as the frequency difference between two signals of equal deflection amplitude, the pips of which intersect 30% down from their peak amplitude.

I-7. OPERATING CONTROLS

a. Front-Panel Controls.

POWER - This toggle switch is used to turn the Panadaptor on and off.

SWEEP WIDTH FACTOR - This is the sweep width control. When it is turned completely clockwise, the maximum band for which the Panadaptor is designed can be seen on the crt screen. As the control is turned counterclockwise, the band is made narrower, but the part that remains visible becomes magnified or spread out. This control is very useful when two or more signals are so close in frequency that they appear to be merged into each other on the crt screen. By turning the control, the sweep width is reduced and the two signals appear to separate, enabling the receiver to be tuned more accurately.

CENTER FREQ - (Center Frequency). This control serves to match the Panadaptor accurately to the companion receiver, so that the signal being heard in the receiver will appear as a pip exactly in the center of the crt screen. Once proper initial alignment has been established, this control is used to maintain or restore the match condition.

GAIN - This control governs the sensitivity of the Panadaptor.

b. Screwdriver-Adjust Controls.

On the left of the front panel, there are seven holes, behind which are seven controls, recessed from the panel and accessible with a screwdriver. Ordinarily, these controls are not used in operation, but they may require an occasional touch-up when adjusting or servicing the equipment. The name of each control is marked on the panel. Four are marked in white, the other three in red. Caution is required in adjusting these controls. The operator should have a thorough understanding of the operation of the set before attempting to adjust them, since the Panadaptor will not perform properly if these controls are misadjusted. This caution applies particularly to the controls marked in red which should normally be adjusted only during the performance of maintenance procedures.

1. The four white (seldom used) controls are:

VERTICAL POSITION - This control moves the baseline up or down on the crt screen. It should be adjusted so that the baseline is as close as possible to the calibration line on the crt screen.

HORIZONTAL POSITION - This control moves the baseline either to the left or to the right and is adjusted to bring the pip of the signal heard on the receiver exactly at the center of the screen at full sweep. It is used in conjunction with the CENTER FREQ control to permit rapid correction of slight center frequency drift which may occur while either the Panadaptor or the receiver is cold. Final adjustment of the HORIZONTAL POSITION control should be made after the adjustment of the CENTER FREQ control.

BRILLIANCE - This control adjusts the intensity or brightness of the line on the screen.

FOCUS - This control adjusts the sharpness of the line on the screen.

There will be little need for adjustment of any of these white marked controls.

2. The three red controls are:

SWEEP WIDTH LIMIT - The upper limit of sweep width obtainable with the SWEEP WIDTH FACTOR control on the front panel is set by this control. Its function is to limit the extent of the f-m oscillator excursion so that the stipulated maximum sweep width is obtained when the SWEEP WIDTH FACTOR control is set at maximum. Note that adjustment of the SWEEP WIDTH LIMIT control will cause a temporary horizontal shift in screen presentation. If this control is adjusted, 15 seconds should be allowed to elapse before any other adjustments are attempted.

BASELINE SIZE - This control is used to adjust the length of the baseline on the crt screen. It should be set so that the baseline extends slightly beyond the calibrated scale at both ends.

SYNCH - This control is used to adjust the speed with which the "spot" sweeps across the screen in synchronism with the ac power source. Normally it is set for 30 sweeps per second when operating from a 60-cycle source of power and for 25 sweeps per second when operating from a 50-cycle source of power.

I-8. TUBE COMPLEMENT

Reference designations, types, and functions of tubes used in the Panadaptor are listed below.

Circuit Reference Symbol	Tube Type	Function
V101	6AC7	2nd R-F Amplifier
V102	6SB7Y	Converter

(continued overleaf)

continued from previous page

Circuit Reference Symbol	Tube Type	Function
V103	6SG7	I-F Amplifier
V104	6SQ7	Detector and 1/2 Vertical Amplifier
V105	2X2A	HV Rectifier
V106	OC3/VR105	Regulator
V107	6AC7	Reactance Tube Modulator
V108	6SL7GT	a. 1/2 Horizontal Amplifier b. 1/2 Vertical Amplifier
V109	3BP1A	Cathode-ray Tube
V110	6X5GT/G	Rectifier
V111	6SL7GT	a. Blocking Tube Oscillator b. 1/2 Horizontal Amplifier
V112	6AC7	1st R-F Amplifier

I-9. TERMS AND DEFINITIONS

PANORAMIC RECEPTION is the simultaneous visual reception of a continuous portion of the frequency spectrum.

This definition distinguishes PANORAMIC RECEPTION from the conventional reception which can be called "uni-signal" reception and which can be either aural or visual or both.

The main distinction between panoramic and uni-signal reception is the following: Panoramic reception is periodic reception over a wide range of the spectrum. Each signal is received at fixed, rapid intervals, for a short period of time. (These signals are received so rapidly as to appear to be continuous). Unisignal reception is continuous reception, of the one signal at a time, over a very narrow range of the spectrum.

COMPANION RECEIVER is the aural receiver with which the Panadaptor is operated.

SWEEP WIDTH is the width of the frequency band, measured in cycles-, kilocycles-, or mega-cycles-per-second, which can be observed in panoramic reception. Sweep width, which corresponds to the range of frequency sweep of the oscillator in the Panadaptor, should not be confused with signal frequency, although both are measured in the same units.

BASELINE is the horizontal line produced on the cathode-ray tube screen by the electron beam sweeping across it.

FREQUENCY SWEEP AXIS is the line along which the signal deflections are produced. It is usually calibrated in frequency according to a given frequency scale.

CENTER FREQUENCY is the frequency of the signal being received on that part of the frequency sweep axis corresponding to zero sweep voltage applied to the reactance modulator. The center frequency of the Panadaptor must correspond with the intermediate frequency of the companion receiver for proper operation.

RESOLUTION of a given signal is the frequency difference, measured along the frequency sweep axis, between the points where its deflection is 30% down from the peak value. This characteristic corresponds to selectivity in ordinary receivers. The smaller the frequency difference, the "better" the resolution is.

SWEEP RATE or SWEEP FREQUENCY is the number of times per second that the electron beam sweeps across the cathode-ray tube.

SCREEN SCALE is the scale adjacent to the baseline which is calibrated in frequency units above and below center frequency for a maximum sweep width setting.

SECTION II
INSTALLATION

II-1. INITIAL INSPECTION

This instrument has been tested and calibrated before shipment. Only minor preparations are required to put the instrument in operation.

If damage to the case is evident when delivery is made, have the person making the delivery describe the damage and sign the notation on all copies of the delivery receipt.

Most public carriers do not recognize claims for concealed damage if such damage is not reported within fifteen days after delivery. All shipping containers should be opened and the equipment inspected before fifteen days elapse.

If damage is found, whether concealed or obvious when delivered, call or write the carrier and ask that an inspection be made by their agent.

Although the carrier is liable for any damage in the shipment, Panoramic Radio Products, Inc. will assist in describing and providing for repair or replacement of damaged items.

The equipment is shipped with all tubes installed in their sockets. Check that all tubes are properly seated.

II-2. INTERCONNECTING PROCEDURE

The Panadaptor is normally wired for a 115 -volt, 50-60 cps, single-phase, alternating current power source. The power connections can be set at the factory for 230-volt operation. Equipment wired for 230-volt operation is marked with the input power requirements adjacent to the power input receptacle. If it is desired to change from a 115 to 230 volt operation, or vice versa, change the power transformer connections as shown on the schematic diagram, and change the power input receptacle marking accordingly.

a. Locate the Panadaptor near the companion receiver, placing it so that direct sunlight or other strong light does not fall upon the screen. If possible, avoid mounting the unit over the ventilation holes of the companion receiver. Check that the receiver has an intermediate frequency which corresponds to the input center frequency of the Panadaptor, i.e., 30 mc.

b. Connect the Panadaptor to the receiver using the coaxial cable supplied with the equipment. This cable has a male plug at each end; the UHF-type connector fits into the female input receptacle at the rear of the receiver. (If the companion receiver is not provided with a receptacle for operation with the Panadaptor, consult Clarke Instruments, Division of National Electric Machine Shops, Inc., 919 Jesup-Blair Drive, Silver Spring, Maryland for appropriate action.

c. Connect the Panadaptor and the companion receiver to the power line, and turn them ON. Allow both instruments to "warm up" for at least one-half hour.

II-3. INSTALLATION ADJUSTMENTS AND CHECKS

a. POWER. Set the switch to the ON position. With the BRILLIANCE control set between one-half and two-thirds of the maximum clockwise position, a baseline trace should appear on the crt screen within two minutes, as a blurred or sharp line.

b. FOCUS. (semi-adjustable control, marked in white). Turn this control through its entire range. The sharpness of the trace will vary. At one particular setting of the FOCUS control the baseline will appear sharpest. Keep the control at that setting.

c. BRILLIANCE. (semi-adjustable control, marked in white). Turn this control through its entire range. The intensity of the baseline trace should vary. This is normal. Return the control to a position which results in a bright, sharp trace. Readjust the FOCUS control if necessary.

d. CENTER FREQ. Tune in any station on the companion receiver, using phones or a speaker. The signal should appear as a "pip" on the Panadaptor crt screen directly above the zero (0), that is, exactly in the center of the screen. For best results it is advisable to adjust the mean frequency of the Panadaptor oscillator so that the pip will remain at the center of the screen regardless of the setting of the SWEEP WIDTH FACTOR control. This adjustment, which should be made after the Panadaptor has been allowed to warm up, is performed as follows:

1. Turn the SWEEP WIDTH FACTOR control fully counterclockwise.

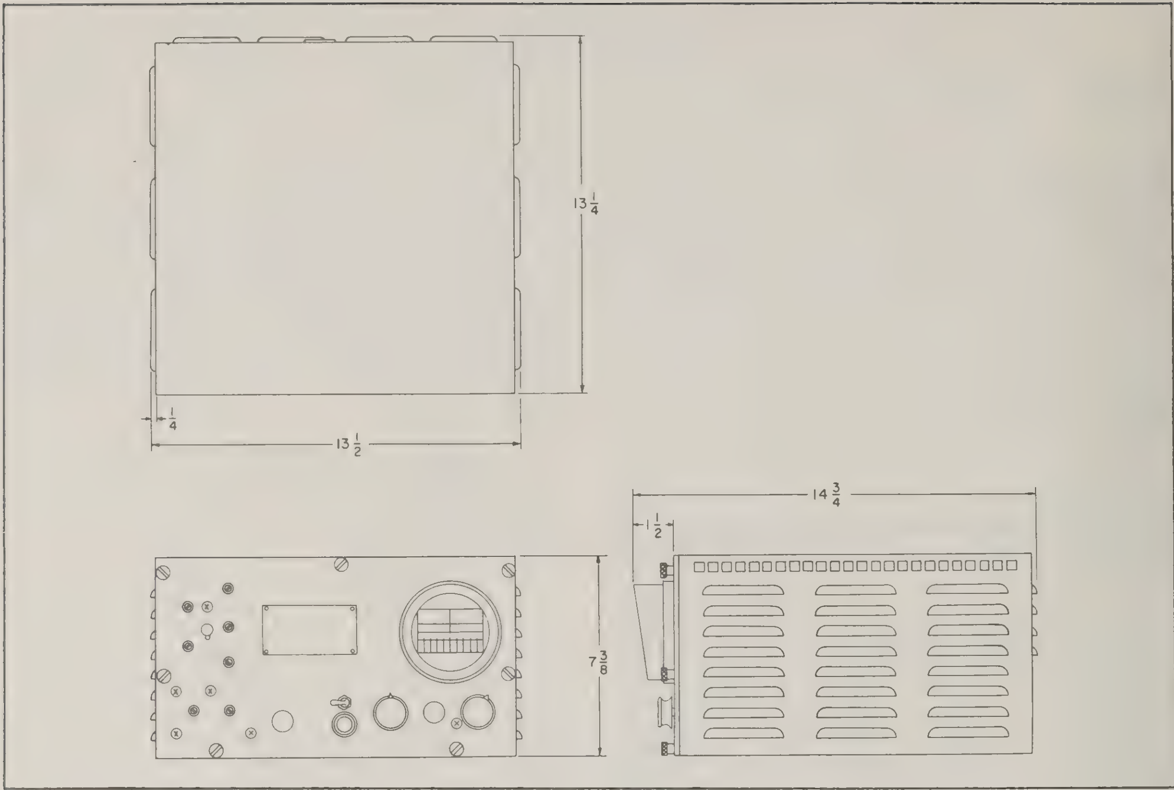


Figure II-1. Outline Dimensional Drawing, Model SA-3, Type T-2000NC, In Cabinet.

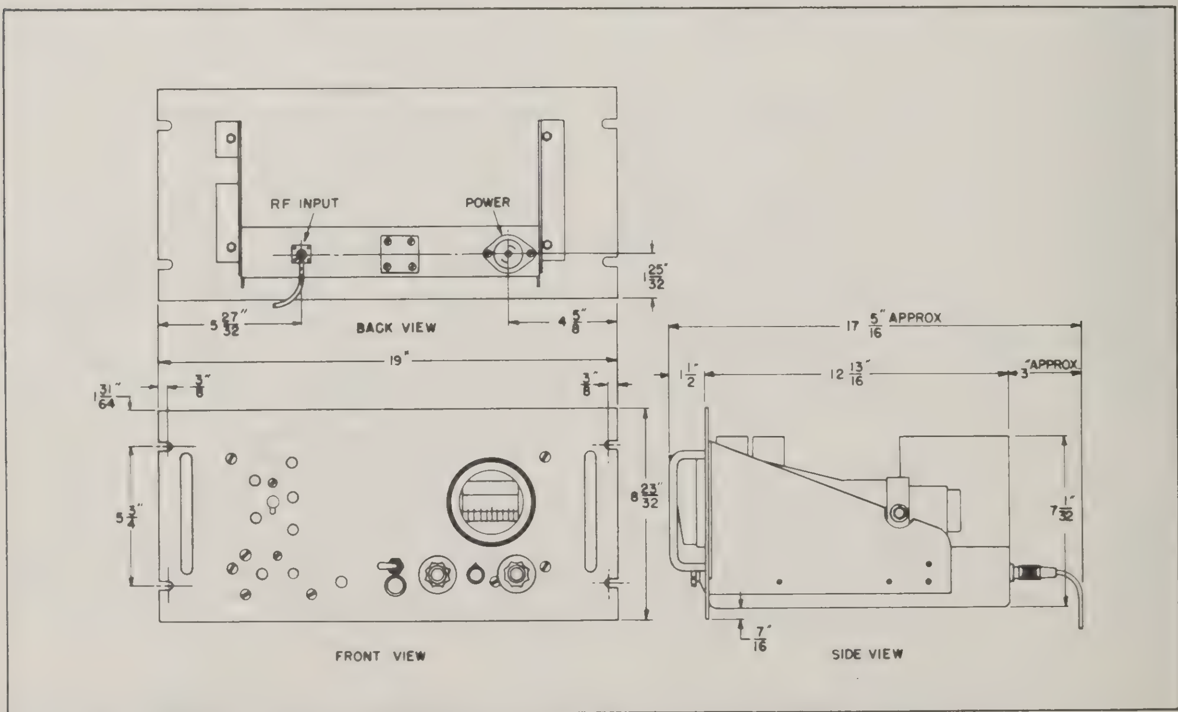


Figure II-2. Outline Dimensional Drawing, Model SA-3, Type T-2000NC, Rack Mount.

2. Rotate the CENTER FREQ control until the deflection pip is centered (indicated by a maximum rise of the baseline).

3. Turn the SWEEP WIDTH FACTOR control fully clockwise. The pip should remain at the center of the screen. If it does not, adjust the HORIZONTAL POSITION control for correct centering, and repeat steps 1, 2, and 3.

The CENTER FREQ control should seldom require adjustment, but incorrect adjustment of this control will result in misalignment between the Panadaptor and the companion receiver, so that the signal being heard on the receiver will not correspond to the signal pip appearing at the center of the Panadaptor screen.

e. GAIN. Rotate this control back and forth. The height of the pip should vary.

f. SWEEP WIDTH FACTOR. Set the controls as outlined for CENTER FREQ. above. With the SWEEP WIDTH FACTOR control turned completely clockwise, vary the receiver tuning until a well-populated band is located. Slowly turn the SWEEP WIDTH FACTOR control counterclockwise. The pips near the edge of the screen will move off the screen, and the pips near the center will appear to "spread out" or separate.

g. SYNCH. (semi-adjustable control, marked in red). This control synchronizes the scanning rate with the a-c power line frequency; 30 cps for a 60-cps line frequency and 25 cps for a 50-cps line frequency. Starting with the SYNCH control in the full counterclockwise position, slowly rotate this control until the baseline becomes "locked" in. Signals on the screen will now remain steady with no horizontal drifting.

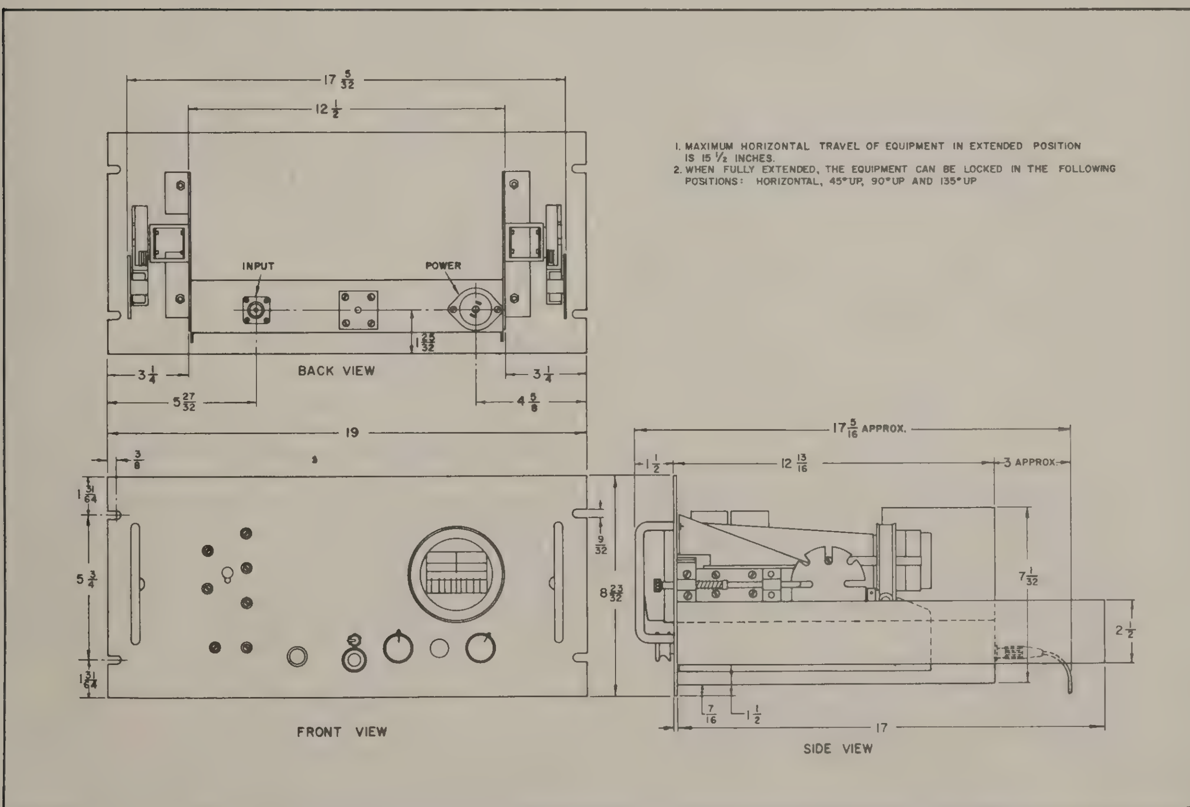


Figure II-3. Outline Dimensional Drawing, Model SA-3, Type T-2000NC, Rack Mounted with Slides.

SECTION III
OPERATION

III-1. GENERAL OPERATION

a. Turn the POWER switch on the Panadaptor to ON. When the baseline appears on the crt screen (usually within two minutes), set the front-panel controls as follows:

SWEEP WIDTH FACTOR	completely clockwise
BRILLIANCE	for desired brightness
FOCUS.............	for sharpest trace
GAIN	at center of its range

b. Turn on the companion receiver, and set its controls as follows:

R-F GAIN	near maximum
A-F GAIN	normal
AVC	OFF
SELECTIVITY Controls	Normal
CRYSTAL..............	IN or OUT
BFO	OFF
BANDSWITCH	to band of interest
ANL	OFF
ANTENNA TRIMMER	Normal for the antenna in use.

c. If the band to which the receiver is tuned is well "populated", signal deflections of various amplitudes will be visible on the screen. If they are not, or if a particular signal is being sought, rotate the receiver tuning dial until the signal or signals come into view. Tune in the signal so that it is heard through the receiver. The deflection corresponding to the signal should be directly over the zero calibration line on the screen. If it is not, center it as follows:

1. Tune in the station as accurately as possible.

2. Set the SWEEP WIDTH FACTOR almost fully counterclockwise, keeping the spread-out peak centered on the screen with the CENTER FREQ control.

3. Return the SWEEP WIDTH FACTOR control to the fully clockwise position.

4. If the peak is now off-center, carefully adjust the HORIZONTAL POSITION control until the deflection is centered.

d. Always use as low a GAIN setting as is possible without losing sight of the pips on the screen caused by weak stations heard on the receiver. Excessively high gain may cause erratic noise deflections to appear. This may result in confusion, since it is often difficult to differentiate between signals and noise.

e. When AVC is used in the receiver the signal appearing at the center of the screen will control the height of other pips. Therefore, if a strong signal is tuned in, weaker adjacent signals may become so attenuated that they do not appear on the screen. In most applications, it will be found expedient to operate the receiver with the AVC turned off.

f. The method of determining the frequency of any pip is best illustrated with an example. Suppose, for instance, a pip appears at the fourth calibration line to the right of the zero (as shown in Figure III-1), and the receiver is tuned to 4310 kc. If the SWEEP WIDTH FACTOR control is set to maximum, each vertical calibration line will be equivalent to a 200-kc separation. The pip will therefore represent a signal 4 X 200 kc or 800 kc above 4310 kc - which is 5110 kc.

NOTE

The polarity markings (- and +) on the screen calibration, representing frequency below or above center frequency, are applicable only when the receiver local oscillator is higher in frequency than the incoming signal. When the receiver is of the type where the local oscillator tracks below the incoming signal, the polarity will be reversed. In such a case the pip cited in the above example would represent 800 kc below 4310 kc, or 3510 kc.

To check the relation between the oscillator and incoming frequencies, slowly tune the receiver to higher frequencies.

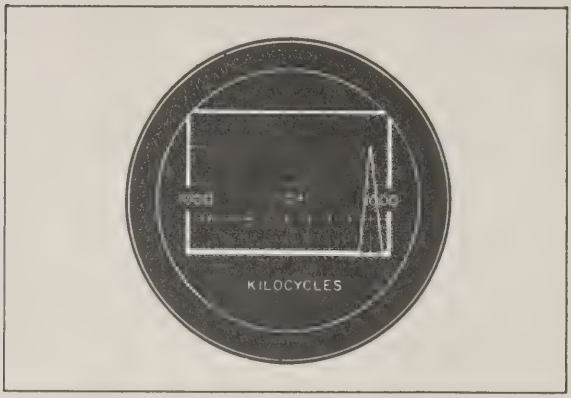


Figure III-1. Determination of Frequency.

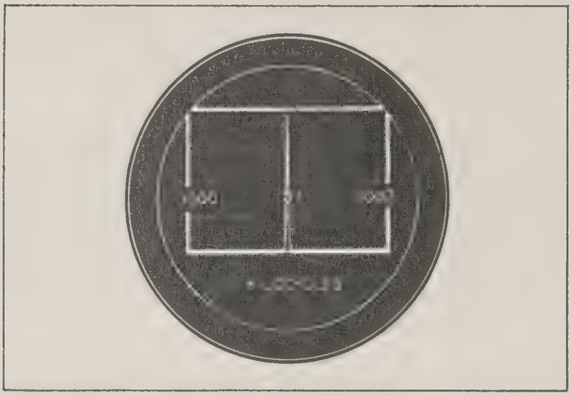


Figure III-2. Constant Carrier Signal (at Approximately Maximum Sweep Width)

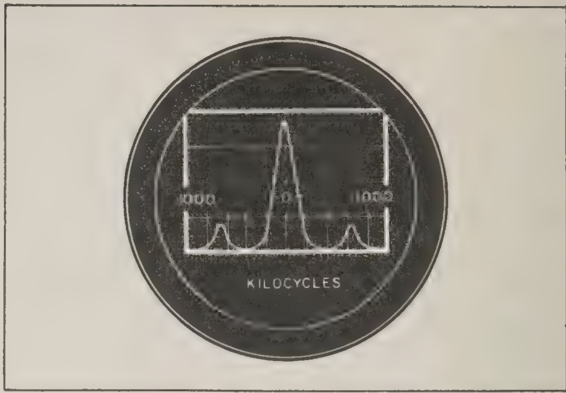


Figure III-3. Amplitude Modulated Carrier (at Reduced Sweep Width)

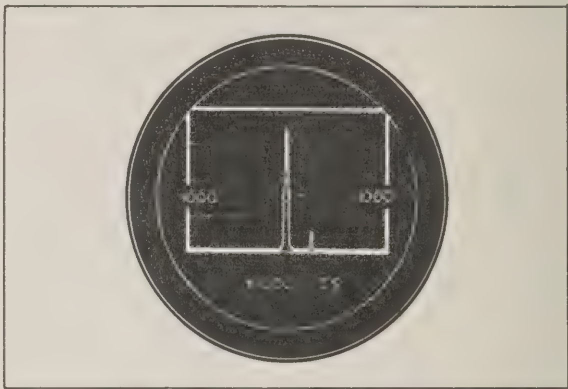


Figure III-4. Single Sideband Modulation.

If the deflections move from right to left, the local oscillator is tracking above the incoming signals; if they move from left to right, the local oscillator is tracking below the incoming signals.

III-2. INTERPRETATION OF SCREEN PRESENTATIONS

With a little experience, the operator of the Panadaptor will be able to recognize the visual character of the various types of signals.

a. A constant carrier (Fig. III-2) appears as a deflection of fixed height.

b. An amplitude modulated carrier (Fig. III-3) appears as a deflection of variable height. Voice or music modulation causes the carrier to vary irregularly. A constant tone modulation of low frequency will produce a series of convolutions varying in height, their number being determined by the modulation frequency. As the modulation frequency increases the convolutions move toward the two sides of the deflection, and the sidebands tend to become visible. When the modulation frequency is increased, it becomes possible to separate the two sidebands by reducing the sweepwidth of the Panadaptor. The higher the frequency of modulation, the further away these sidebands will move from the center deflection, representing the carrier. It should be remembered that due to possible non-linear amplification of the receiver or of the Panadaptor, or of both, over a wide band, the two sidebands may appear unequal in height, even though they are of equal strength. Their relative heights may vary as the receiver is tuned and as the deflection moves from one end of the crt screen to the other.

c. Single sideband modulation (Fig. III-4) appears as two carriers of slightly different frequency. (See "Signal Interference" below.)

d. A carrier frequency-modulated at low rate appears as a pip which wobbles sideways.

e. A CW signal appears and disappears in step with the keying of the transmitter. During

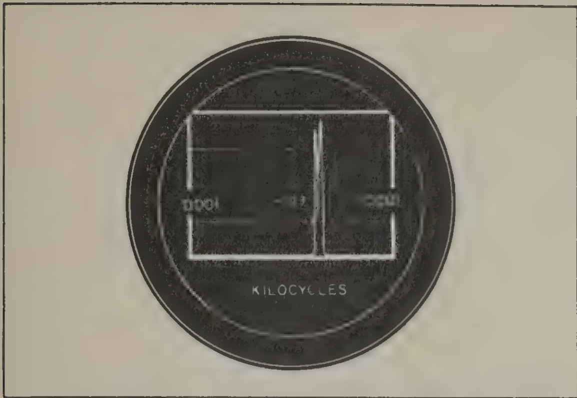


Figure III-5. Two Interfering Carriers at Maximum Sweep Width.

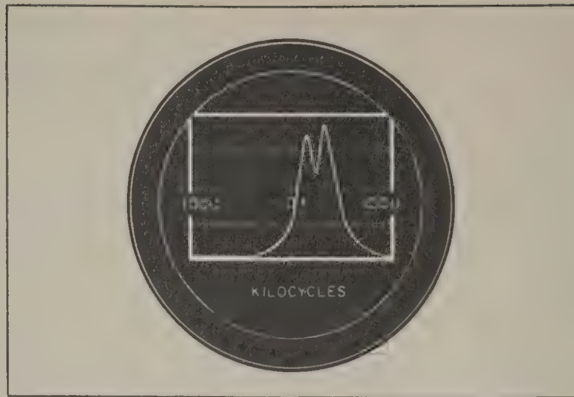


Figure III-6. Two Interfering Carriers at Reduced Sweep Width.

the moments when the signal is off, the frequency sweep axis is closed at the base of the signal. In very rapidly keyed CW transmission, the deflection and the baseline are seen simultaneously.

f. A MCW signal appears like a CW signal of periodical varying height. If the modulation rate is high, sidebands will appear as explained above.

g. Signal interference (Fig. III-5, and III-6). Two signals which are so close in frequency as to cause aural interference (beats) may appear on the screen as a single deflection, varying in height as with a modulated signal. As the frequency separation is increased, the deflection appears to be modulated on one side only. Further increase of frequency will cause a "break" in the apex of the deflection. By reducing the sweepwidth of the Panadaptor, the respective deflections can be gradually separated.

h. Transient disturbances generally examined are of two types: periodic and aperiodic transients.

Periodic transients, such as produced by motors, vibrators, buzzers, etc., appear as signals moving along the frequency sweep baseline in one direction or another. Thus, an engine which is accelerating will produce a set of deflections which may move first in one direction, slow down, stop, and then move in the opposite direction. This is caused by the fact that the Panadaptor is sweeping at a fixed rate, whereas the transient occurs at a variable rate. The images stand still on the crt screen when there is synchronism between the two. If the transient disturbance is synchronized with the 60 cps line, the "noise" appears as a fixed signal which does not move on the screen when the receiver is tuned but varies in height only. Such deflections may appear like amplitude-modulated signals or like steady carriers.

Aperiodic transients, such as "static", appear as irregular deflections and flash along the whole frequency sweep axis.

i. Images will be distinguishable from normal signals by the fact that they move in an opposite direction than do the normal signals when the external oscillator is being tuned. Such images are most likely to appear on the higher frequency ranges of the receiver.

j. Harmonics produced in the Panadaptor by the beating of very strong signals with harmonics of the oscillator will be distinguishable from other signals by the fact that they move across the crt screen more rapidly than do the normal signals when the receiver is being tuned. (Twice as fast for second harmonic spurious signals). Generally, a reduction in the gain of the Panadaptor will eliminate this type of spurious signal.

k. Diathermy apparatus using an unfiltered or A-c power supply will produce a periodic disturbance which will cause a deflection to appear on certain portions of the crt screen and disappear on others. This is due to the fact that such equipment emits a pulsating signal in synchronism with the power line. On the other hand, the Panadaptor is also sweeping the spectrum in synchronism with the line, but at a lower frequency (30 cycles). Only when a certain phase relationship exists is it possible for the Panadaptor to receive those periodic pulses.

l. Spurious signals. If the signal strength exceeds a certain value, the deflection caused by any signal breaks up into a series of parallel deflections, somewhat simular in appearance to sidebands. These spurious signals can take place in either the Panadaptor or the receiver on extremely strong signals. Attenuation of the input level will remedy this.

SECTION IV
THEORY OF OPERATION

IV-1. INTRODUCTION

The Panadaptor is essentially an automatic-scanning heterodyne receiver which provides a visual display of signals present within a given band. It is operated in conjunction with a companion receiver which is used to tune in the portion of the spectrum to be observed. The Panadaptor is connected to the receiver at the output of the mixer or converter stage. Appearing at this point is a broad band of signals which centers about the intermediate frequency of the receiver. The width of this band depends on the selectivity of the receiver front-end. Because the receiver i-f section is sharply tuned, only one of the signals in this band is normally passed and subsequently heard.

The input amplifier of the Panadaptor, however, has a 2-mc bandpass within 3 db of the center frequency. The Panadaptor response curve is double-peaked to compensate for the selectivity of the receiver front-end, and the overall response curve is therefore relatively flat, (See Figure IV-1.) making it possible to examine signals within a relatively broad band.

The relative amplitudes of the signal indications will be determined by the product of the Panadaptor response and the preselection of the receiver. Receiver front-end selectivity will differ among receivers and from band to band; therefore the relative amplitudes of the indications may not coincide with actual relative signal levels.

The Panadaptor consists basically of a broad-band r-f amplifier, a swept local oscillator and converter, intermediate-frequency amplifier, detector, cathode-ray tube indicator, and associated sweep circuits. (See Block Diagram, Figure IV-2).

The swept oscillator progressively heterodynes in order of frequency with those signals appearing across the output of the broad-band amplifier to produce a difference frequency which is passed and amplified by the intermediate-frequency section, tuned to 3.5 mc. There are two inputs to the mixer stage; a band of input frequencies from 29 mc to 31 mc, and the swept oscillator signal, which successively covers each discrete frequency from 32.5 mc to 34.5 mc. At each instant, one and only one of the incoming frequencies will heterodyne with the oscillator frequency to produce a difference frequency of 3.5 mc. For example, when the instantaneous frequency of the oscillator is 34.3mc, an incoming signal of 30.8 mc will produce a difference frequency of 3.5 mc. (See Figure IV-3.) This difference frequency will pass through the i-f stage and appear as a deflection on the crt screen at the instant the crt beam is moving past the fourth calibration line to the right of the zero center.

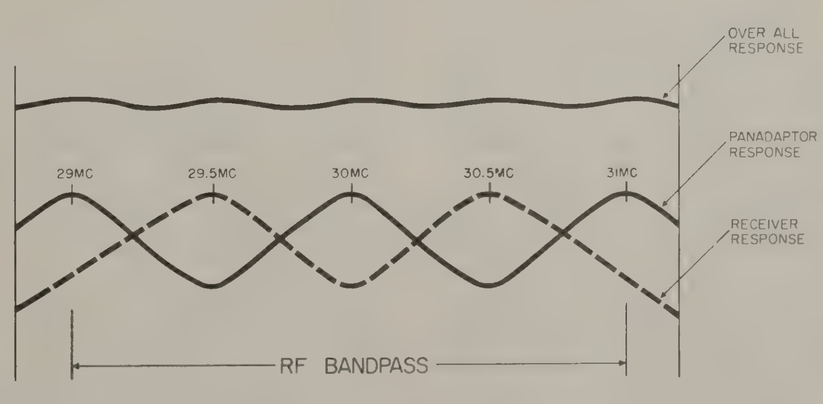


Figure IV-1. Overall Response of the Panadaptor, as Determined by the Bandpass Characteristics of T101 and T102.

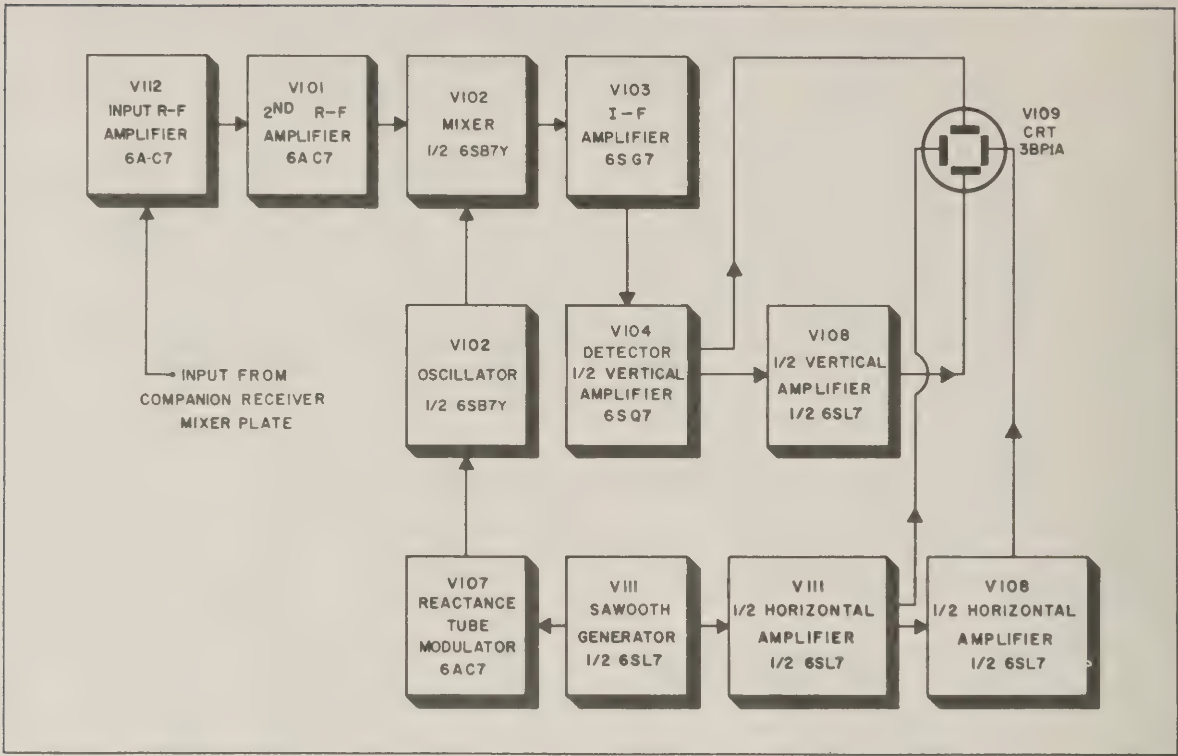


Figure IV-2. Block Diagram, Panadaptor Model SA-3, Type T-2000NC.

Since the receiver i-f is 30 mc, a signal of 30.8 mc would represent a frequency of 800 kc above* center frequency. Thus, a pip on the fourth calibration line to the right of the zero center (as in Figure III-1) represents a frequency 800 kc above the one to which the companion receiver is tuned.**

The output voltage of the i-f section, which is proportional to the amplitude of the incoming signal, is detected, amplified, and applied to the vertical deflection plates of the cathode-ray tube. Oscillator sweep is obtained from a sawtooth-modulated reactance tube circuit. The same sawtooth generator which supplies the necessary modulating voltage provides for the horizontal sweep of the crt beam. Therefore, for each discrete point on the horizontal axis of the crt there is a corresponding local oscillator frequency and consequently a corresponding signal frequency.

* The input to the Panadaptor is the result of the heterodyne action of the receiver mixer. Since the receiver oscillator normally tracks above the incoming signal, a higher frequency incoming signal will produce a lower difference frequency and hence a lower frequency to the Panadaptor input.

** This is true only when the SWEEP WIDTH FACTOR control is set at maximum.

IV-2. CIRCUIT DESCRIPTION (See Schematic Diagram, inside rear cover)

a. Input Section. T1, an untuned step-up auto-transformer, couples the input connector J101 to the input tube V112. The input tube, a 6AC7, is operated as an r-f amplifier. T101, a double-tuned bandpass transformer, couples V112 to V101. The transformer is permeability-tuned by means of two adjustable iron cores and a variable coupling coil. The secondary of T101 is connected to the grid of V101, which is an r-f bandpass amplifier tube. T101 is tuned to pass a band centered at the intermediate frequency of the receiver (30.0 mc).

The gain of the stage is controlled by potentiometer R101 connected in the cathode circuit of V112. It is mounted on the front panel and marked GAIN. T102 is the output bandpass transformer for V101. Its windings (T and B) are permeability-tuned by means of adjustable iron cores. It is tuned in the same manner as is T101.

b. Mixer. Section V102A of the 6SB7Y functions as the frequency mixer. Signals appearing

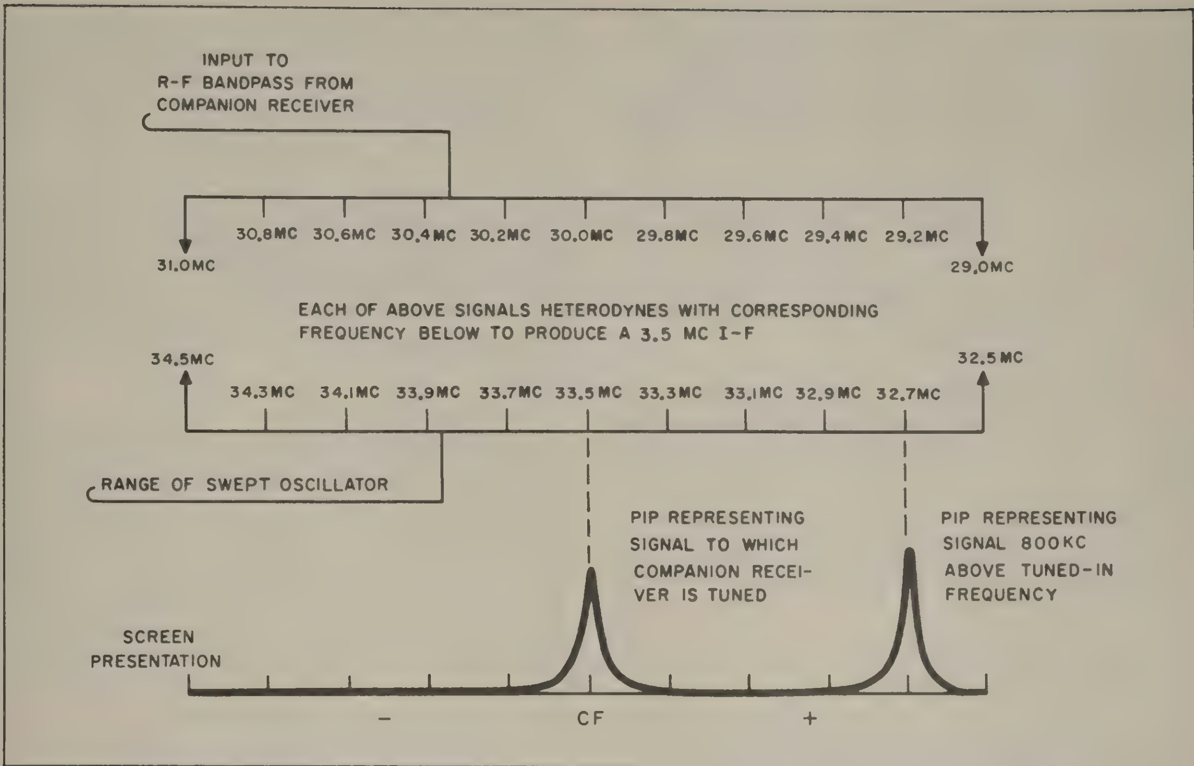


Figure IV-3. Relationship between R-F Bandpass, Swept Oscillator Frequencies and Screen Presentation.

across the secondary of T102 are applied to the control grid of V102A. At the same time, the screen grid of V102A is impressed with a frequency derived from the plate of V102B, the swept oscillator. These two frequencies heterodyne in the mixer stage, producing an output frequency on the plate of V102A which is equal to the difference between the two instantaneous incoming frequencies.

c. Oscillator. Section V102B of the 6SB7Y functions as the swept oscillator. Z101 is the tank of the oscillator and is connected to the reactance tube V107, a 6AC7. The proper mean frequency of the oscillator is the sum of the intermediate frequencies of the receiver and the Panadaptor. Small adjustments of the mean frequency may be accomplished with the CENTER FREQ control mounted on the front panel. However, in extreme circumstances, it may be necessary to re-align the Panadaptor by tuning the oscillator coil Z101, as described in Section V-5, ALIGNMENT.

d. Reactance Tube Modulator. The reactance tube V107, a 6AC7, connected to the oscillator through a phase-shifting network, is effectively a part of the oscillator tuned circuit. When its control grid voltage is varied, the reactive plate current of the tube changes, varying the frequency of the oscillator. The voltage variation on the grid is derived from the sawtooth output of the sweep voltage generator, V111.

The sawtooth on the reactance tube grid rises linearly from zero to a maximum positive voltage, falls suddenly to a maximum negative voltage, then rises again linearly to zero, completing one cycle. In coincidence with this waveform, the oscillator sweeps upward in frequency, suddenly snaps back past the mean frequency to the minimum frequency, and then sweeps back to the mean frequency. The extent of the oscillator frequency excursion is determined by the amplitude of the sawtooth voltage applied to the grid of the reactance tube V107. The SWEEP WIDTH FACTOR control R137 regulates the amplitude of this applied sawtooth voltage. If the sawtooth voltage is reduced to zero the reactance tube will no longer produce a sweep in oscillator frequency and the oscillator will stabilize at its mean frequency. The CF PAD, R139, which is connected in the cathode circuit of V107, serves to adjust the Panadaptor for a linear frequency sweep at the correct center frequency. This pad, which is mounted on the chassis near the cathode-ray tube, has been pre-set at the factory. Unless the Panadaptor has been serviced, it will require no adjustment. If V107 has to be replaced by another 6AC7 tube, a change in center frequency

may result because of the variation in tube characteristics. This may be offset either by readjusting the CF PAD or by trimming the oscillator coil Z101. Small changes in center frequency can be effected with the CENTER FREQ control, R142.

NOTE

Do not attempt adjustments of the CF PAD until completely familiar with the alignment procedure.

The SWEEP WIDTH LIMIT control R136 is a screwdriver-adjust pad recessed behind the front panel. It is adjusted so that with the SWEEP WIDTH FACTOR control set at maximum clockwise position, the sweep width is equal to the specified maximum, i.e., 2 mc. The panel markings "0" and "0.5" for the SWEEP WIDTH FACTOR control are approximate, while the "1.0" marking is accurate.

e. Sweep Voltage Generator. The sweep or sawtooth voltage generator consists of a blocking tube oscillator, 1/2 of V111, a BTO transformer, T103, and associated components. V111 is a 6SL7GT twin triode, one half of which is used to generate the sawtooth voltage and the other half as part of a push-pull amplifier (with 1/2 of V108, another 6SL7GT tube).

This circuit is capable of operating as a "free-running" oscillator, generating a sawtooth voltage of any frequency between approximately 20 and 40 cycles per second. A small amount of alternating voltage of power line frequency is fed into the grid of the tube from the filament winding of the main power transformer T104. This voltage serves to synchronize or "lock" the sweep frequency to a sub-multiple of the line frequency. If the line frequency is 60 cps, the sweep frequency is locked to 30 cps; if the line frequency is 50 cps, the sweep is set for 25 cps.

The sweep frequency is adjusted by means of potentiometer R132, in the grid circuit of the BTO tube. This is part of the RC combination whose time constant determines the length of time the tube remains blocked, thereby controlling the sweep frequency. The potentiometer is recessed behind the front panel, and is labelled SYNCH.

The output from the sawtooth generator is fed through a coupling capacitor C125 to the other half of V111. The output of this tube is then applied to one of the horizontal deflection plates of the cathode-ray tube, and also through resistor R151 to the grid of one section of V108. This tube inverts the phase of the sawtooth voltage and then applies it to the opposite horizontal deflection plate of the crt. The magnitude of the sawtooth appearing on the horizontal deflection plates is controlled by R135, BASELINE SIZE. The greater the amplitude of the sawtooth voltage, the longer the horizontal baseline will be.

f. I-F Amplifier. This stage consists of a 6SG7 tube, V103, an input transformer Z102, and an output transformer Z103. These transformers are tuned to 3.5 mc and are adjusted for critical coupling. The gain and band width of the i-f section are controlled by means of the I-F PAD, R115.

g. Detector and Vertical Amplifier. V104 (6SQ7), a duo-diode triode, is used as the detector and vertical amplifier. The diode section serves as the detector, and the triode as one of the vertical amplifiers. The output of the detector is directly coupled to the vertical amplifier, which in turn is directly coupled to one of the vertical deflection plates. The output of the vertical amplifier is also applied through R154 to the grid of the second half of V108. The output of V108, which is 180° out of phase, is in turn fed to the other vertical deflection plate.

The vertical position of the baseline trace is controlled by R143 which is recessed behind the front panel and marked VERTICAL POSITION. The horizontal position of the trace is controlled by R147, which is also recessed behind the panel and is marked HORIZONTAL POSITION.

h. Cathode-Ray Tube. The cathode ray tube V109, a 3BP1A, consists of a number of elements operating at high potentials. When the potentials are applied in a proper ratio they cause the electrons emitted from the cathode to be accelerated to a high velocity and focused into a sharp beam. This high velocity electron beam continues toward the face of the tube, strikes the phosphorescent coating, and causes a green glow to appear as a dot on the screen of the cathode-ray tube. There are two sets of parallel plates in the cathode-ray tube. By applying a potential between the plates in one of the sets, the beam (green dot) is deflected in a horizontal direction. Similarly, a voltage applied between the other two plates deflects the beam (green dot) in a vertical direction. As a result of these rapid, simultaneous deflections the moving beam traces a continuous pattern on the screen of the cathode-ray tube.

The brightness of the trace on the screen is dependent on the amount of electrons striking the screen. By varying potentiometer R162, which is in the cathode circuit of the crt, the current in the crt can be varied, thereby either increasing or decreasing the brightness of the trace. This

screwdriver-adjust control, is labelled BRILLIANCE and is recessed behind the front panel. Potentiometer R160 is used to control the sharpness of the trace on the screen. This screwdriver-adjust is marked FOCUS and is also recessed behind the front panel.

i. Power Supply. The power supply of the Panadaptor consists of the main power transformer T104, two rectifier tubes V105 (2X2) and V110 (6X5), a voltage regulating tube V106 (VR-105), and a filter network. The power transformer is normally wired for 115 volt input.

The output of the low voltage rectifier (V110) is filtered by chokes L101A and L101B (in a common case) and capacitors C112, C113, and C114. The filtered output from the low voltage rectifier feeds the voltage regulating tube V106 (VR-105). This regulated 105 volt output supplies the necessary voltages for the plate of the 6AC7 input r-f amplifier (V112), the screen of the 6U8 mixer-oscillator (V102), and 6AC7 reactance tube (V107). The 2X2 high voltage rectifier tube (V105) supplies the DC high voltage necessary for the proper operation of the cathode-ray tube.

CHAPTER V
SERVICE AND MAINTENANCE

If trouble develops in this equipment which cannot be corrected by following the procedures outlined in the following paragraphs, it is recommended that the instrument be returned to Panoramic Radio Products, Inc. for servicing. Before returning the instrument, fill out and mail the Repair and Maintenance Form bound in the rear of this Manual. You will receive from our Service Department either the necessary service data or shipping instructions.

Upon receipt of shipping instructions, forward the instrument prepaid to the factory. If requested, an estimate of charges will be made before work begins.

V-1. RECOMMENDED TEST EQUIPMENT

In order to properly service and align the Panadaptor, the following test equipment should be available:

a. Signal Generator. (Measurements Corporation Model 82, or equivalent).

b. Vacuum-tube Voltmeter. (RCA Model WV-77B, or equivalent).

c. Cathode-ray Oscilloscope. (Optional, if examination of the sawtooth voltage waveform is desired.)

V-2. REMOVAL OF CHASSIS FROM CABINET

To remove the chassis from the cabinet, use the following procedure:

a. Disconnect the power cable from the a-c line. Turn the plug at the chassis end of the cable to the left and disengage.

b. Disconnect the input cables by unscrewing the connectors at the Panadaptor end of the cables.

c. Unfasten the seven panel thumbscrews and the center screw at the rear of the cabinet.

d. Grasp two of the thumbscrews on the panel and pull forward.

WARNING

Operation of this equipment involves the use of high voltages which are dangerous to life. Maintenance personnel must at all times observe all safety precautions. Do not change tubes or make adjustments inside equipment with high voltages on. Under certain conditions dangerous potentials may exist in circuits with power controls in the OFF position due to charges retained by capacitors, etc. To avoid casualties always remove power and discharge and ground components before touching them.

V-3. INSPECTION AND REPLACEMENTS

a. Inspection

All components of the Panadaptor should be given a thorough inspection at regular intervals, and whenever maintenance requires removal of the unit from its cabinet. Moisture may cause deterioration of material and produce generally unsatisfactory operation. Dust and dirt materially affect both electrical and mechanical operation.

Keep the various parts clean. Check accessible connections and tubes regularly to make sure that all contacts are clean and tight and that tubes are held securely in their sockets.

b. Replacement

All tubes are accessible at the top of the chassis. The pilot light is located behind the green indicator on the front panel. This lamp is a bayonet type and is removed by pressing down slightly in the socket and turning counterclockwise. The fuse is located on the rear apron of the chassis. It is removed by pushing in the fuse holder cap and turning it approximately 1/8 inch counterclockwise.

CAUTION

Never replace a fuse with one of a higher rating. If a fuse burns out immediately after replacement, DO NOT replace it a second time until the cause has been removed.

c. Removal of Cathode-Ray Tube.

1. Follow procedure for removal of chassis from cabinet (paragraph V-2, above)

2. Loosen the tube clamp and lift shield fingers.

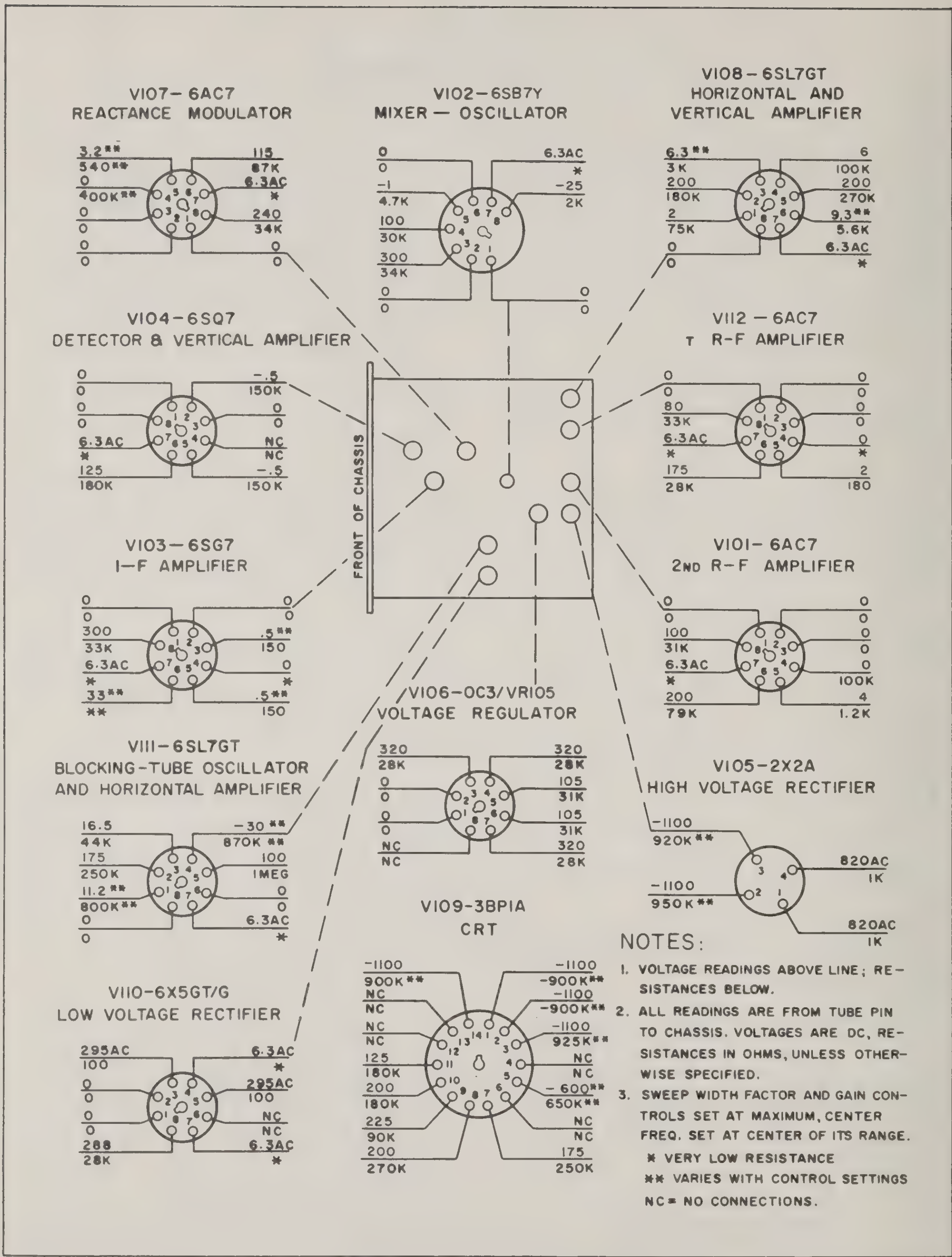


Figure V-1. Tube Location Chart, and Voltage-Resistance Readings, Model SA-3, Type T-2000NC

3. Grasping the tube at its base, ease it out through the metal hood or shield which forms part of the front panel. Note that the cathode-ray tube is protected by a sponge rubber boot which will come out with the tube when it is removed. This boot also serves to hold the calibrated green filter screen in place.

4. Remove the boot by pulling it off the cathode-ray tube.

d. Vacuum Tube Replacement

Vacuum tubes should be checked on a reliable tube checker. An indication of "GOOD" on a tube tester does not necessarily mean that a tube will function properly in its circuit, but a "REPLACE", "BAD", borderline indication usually means that better service will result if the tube is replaced. The average commercial tube tester should not be called upon to give more information than this. Many questions regarding the condition of a particular tube in a given circuit can be answered by substituting a good tube in the same location.

V-4. TROUBLESHOOTING

Careful observation, while operating the various controls, may pinpoint troubles to a specific stage or circuit. Some faults, such as loss of sensitivity, misalignment due to tube aging or failure, or other operational troubles may be isolated to a specific stage by careful observation of the screen presentations.

When a component is replaced in any r-f or i-f circuit, it must be placed in exactly the same physical position as was the original. A part which has the same electrical value but different physical size may cause trouble in high-frequency circuits. Pay particular attention to proper grounding when replacing components. Failure to observe these precautions may result in decreased gain or the possibility of oscillation in the circuit.

Table V-1 is supplied as an aid in locating troubles in the Panadaptor. It lists some symptoms which may be observed, and the specific circuit stage or circuit element which is the probable source of trouble. Once the trouble has been localized to a stage or circuit, a tube check and voltage and resistance measurements should ordinarily be sufficient to isolate the defective part or parts. A tube check implies the investigation of the components associated with the tube as well as a check of the tube itself. Normal voltage and resistance measurements are shown in Figure V-1.

V-5. VOLTAGE AND RESISTANCE MEASUREMENTS

Figure V-1 is a bottom view of the Panadaptor showing the tube locations, with voltage and resistance measurements from tube pins to chassis ground. The readings were taken on a normally functioning set, using a Triplett Model 630 VOM, (20,000 ohms per volt). In some cases, variations in normal readings may exist due to differences in control settings.

TABLE V-1. TROUBLESHOOTING

SYMPTOM	PROBABLE TROUBLE	CORRECTION
1. No illumination on the screen when the POWER switch is turned to the ON position. Pilot lamp does not light.	A-C power is not being supplied to the power supply or the Panadaptor.	Check interconnecting cables. Check for input voltage.
	Open fuse F101 in power supply.	Replace fuse. If it blows again, check filter capacitors C111 through C116 in power supply. Check all filters and bypass capacitors.
	Transformer T104 defective.	Check transformer output voltages.
2. Indicator operates normally but pilot lamp does not light.	Pilot lamp or pilot lamp socket defective.	Replace pilot lamp. Check pilot lamp socket.

continued overleaf

SYMPTOM	PROBABLE TROUBLE	CORRECTION
3. No illumination is observed on the screen of the crt. Pilot lamp lights.	Improper adjustment of BRILLIANCE or FOCUS controls. Improper adjustment of HORIZONTAL POSITION or VERTICAL POSITION controls.	Adjust these controls. Use the procedure outlined in Paragraph II-3.
	Failure of B+ or high-voltage supply.	Check V105, V106, V110. Check power supply circuit.
	Defective crt V109.	Change V109.
4. With the GAIN control turned completely counterclockwise, a dot or short line is observed on the screen, but a horizontal baseline (horizontal sweep) is not obtained.	Faulty sweep stage.	Check tubes V108 and V111 and their tube socket resistances and voltages.
	Improper adjustment of BASELINE SIZE control.	Adjust this control, use the procedure given in Paragraph I-7b.
5. With the GAIN control turned completely counterclockwise, the horizontal baseline is obtained, but it is unstable.	Horizontal oscillator circuit not synchronized.	Adjust the SYNCH. control; use the procedure given in Paragraph I-7b.
	Faulty sweep stage.	Check tubes V108 and V111 and their tube socket resistances and voltages.
6. Horizontal baseline trace appears normal, but no vertical deflection signal is observed when the GAIN control is turned in the clockwise direction.	No input signals; amplitude of input signal is too low; input signals are at an incorrect frequency.	Check the r-f cables from the companion receiver. Check isolating element and connections. Check tubes V112, V101, V102, V103, and V104, and their tube socket resistances and voltages.
	Improper alignment.	Align, following the procedure given in Section V-6.
7. With the SWEEP WIDTH control turned completely clockwise, the vertical deflection representing a 30 mc signal does not appear on the horizontal baseline at the zero line of the calibrated scale.	Improper adjustment of the CENTER FREQ. control and/or the HORIZONTAL POSITION control.	Adjust these controls, using the procedure given in Sections I-7 and II-3.
8. The frequencies of signals, as determined by their position on the horizontal baseline in reference to the calibrated scale are not indicated correctly.	Improper alignment of the bandpass amplifier.	Perform the alignment procedure given in Paragraph V-6.
	Tubes V106 or V107 defective.	Check tubes and replace if necessary.

SYMPTOM	PROBABLE TROUBLE	CORRECTION
9. With the SWEEP WIDTH control set at its maximum clockwise position, the vertical deflection (representing a signal) does not appear as a peak, but rather as a shift in the baseline.	Defective reactance tube modulator stage.	Check Tube V107, and the tube socket resistances and voltages. Check the resistances of network Z101.
10. The length of the horizontal baseline does not cover the diameter of the screen, with the controls properly adjusted.	Defective stage in the horizontal sweep circuits.	Check Tubes V108 and V111 and the tube socket resistances and voltages.
11. The amplitude of the pips on the screen is low with the GAIN control turned completely clockwise.	Input signals of very low magnitude, or improper connections of the r-f cable.	Check the input signal, the r-f cable, and the isolating element.
	Improper alignment.	Realign, using the procedures given in Paragraph V-6.
	Defective i-f stage.	Check Tube V103 and the tube socket resistances and voltages.
	Improper adjustment of the I-F GAIN control.	Adjust this control.
12. The screen of the crt contains burned spots.	Defective crt.	Slight adjustment of the VERTICAL POSITION control may allow the illumination to be observed in a screen area free from burned spots. If this is not possible or practical, the crt must be replaced.
13. The Panadaptor operates normally except that some vertical pips are present along the baseline which do not move as the frequency of the external signal generator is varied.	Electrical interference, the frequency of which is synchronized with the sweep frequency of the Panadaptor.	In many cases, the trouble may be traced to a nearby electrical appliance connected to the same power source as the Panadaptor, or the trouble may be in the power source. Corrective power filters may be used in the event that the interference is caused by appliances. If the power source is the cause and a motor generator set is being used, corrective filters should be used.
14. Rotation of the GAIN control has no effect on the amplitude of the pip on the screen.	Capacitor C2, or resistor R5 or R6 is defective.	Check and replace if necessary.

V-6. ALIGNMENT

The Panadaptor, Model SA-3, Type T2000NC, has been factory aligned before shipment, and should not require re-alignment under normal conditions. In certain circumstances, such as when a tube has been replaced, touch-up alignment may become necessary due to non-uniformity in the operating characteristics of vacuum tubes. The following section contains a description of the complete factory alignment procedure for the Panadaptor. This procedure should be used only after touch-up alignment techniques have been tried and have failed to yield satisfactory results. DO NOT ATTEMPT TO ALIGN THIS INSTRUMENT UNLESS ALL TUBES AND COMPONENTS HAVE BEEN CHECKED FOR DEFECTS, AND ALL OTHER POSSIBLE TROUBLES HAVE BEEN ELIMINATED.

a. General.

Before attempting to align the Panadaptor, allow the instrument and the signal generator to "warm-up" for at least one-half hour.

NOTE

When signals are fed directly to the INPUT of the Panadaptor from the signal generator, the higher frequencies will appear on the minus (-) side of the screen scale, while the lower frequencies will appear on the plus (+) side. This reversal is natural and is due to the absence of the frequency inversion introduced by the receiver mixer stage during normal operation.

Transformers T101, T102, Z101, Z102, and Z103 are tuned by means of movable iron slugs which can be screwed into or out of their cores. Transformers T101, T102, Z102, and Z103 have windings marked "T" and "B" on the circuit diagram. The "T" windings are tuned through the top of the coils, with the alignment tool provided with the equipment. Use the end of the tool which has a short metal pin through it. When tuning the "T" windings, engage this pin in the slotted, threaded metal cylinder which is attached to the top core.

The "B" windings may be tuned from either the top or the bottom of the coils. If tuning from the top, use the end of the tool which has a screwdriver tip. Move aside the dust cover on the shield, and insert the screwdriver tip through the hollow top core. The tip will engage in a slot on top of the bottom core. When tuning the "B" windings from the bottom, use an ordinary screwdriver.

Transformers T101 and T102, the r-f bandpass transformers, have an additional variable coupling coil, located at the bottom of the transformers. Z101, the oscillator coil, is tuned through the top only, using the alignment tool.

NOTE

Before beginning the actual alignment, connect a .01 mfd capacitor in series with the output lead of the signal generator. Throughout the entire alignment procedure, the signal from the generator must be fed to the appropriate points through this .01 mfd capacitor.

b. I-F Alignment

Set the controls as follows:

SWEEP WIDTH FACTOR . . Fully counterclockwise

IF PAD (on top of chassis) . Fully clockwise

CENTER FREQ . . . . To any position

GAIN . . . . To any position

Set the Signal Generator Output To:	Feed the Signal To:	Procedure
3.5 mc Approx. 100 millivolts	Pin 4 V103 (6SG7)	1. Push Pins 4 and 8 of V103 away from the center of the socket. This will prevent oscillation in the i-f section during alignment. 2. Tune the top core of Z103 for a maximum rise of the baseline trace. 3. Turn the bottom core of Z103 until the screw is flush with the bottom plate bushing of the transformer assembly.

I-F Alignment continued

Set the Signal Generator Output To:	Feed the Signal To:	Procedure
		4. With the screwdriver end of the alignment tool passed through the dust cover hole of Z103, turn the bottom core clockwise until a maximum rise of baseline trace is achieved. (NOTE: There are two positions of the core at which this maximum rise results. Select that position at which a greater number of screw threads is visible; this is the more sensitive of the two positions.) If Z103 is properly tuned, the baseline rise will be at least three crt screen divisions high.
3.5 mc Approx. 2 millivolts	Pin 8 V102 6SB7Y	5. Tune the top core of Z102 for a maximum rise of base-line trace. 6. Turn the bottom core of Z102 until the end of the screw is flush with the bottom plate bushing of the transformer assembly. 7. Using the same procedure as was used for Z103 in Step 4 above, tune the top of Z102 for a maximum rise of the baseline. 8. Trim the top and bottom cores of Z102 and Z103 for maximum elevation of the baseline trace. This rise should be equal to at least three crt screen calibration divisions.

c. Oscillator Alignment

Set the controls as follows:

SWEEP WIDTH LIMIT .... Fully clockwise
CF PAD .... In the center of its range
SWEEP WIDTH FACTOR ...... Fully clockwise
CENTER FREQ .... In the center of its range

Proceed as follows:

Set the Signal Generator Output To:	Feed the Signal To:	Procedure
30 Mc 3 millivolts	Pin 8 V102 (6SB7Y)	1. Tune the core of Z101 until a pip appears in the center of the crt screen. (If the pip is very small or cannot be seen when the signal level is 3 millivolts, the oscillator may be at the wrong frequency.) Turn the core of Z101 counterclockwise until a high level pip is centered on the crt screen.
31.0 Mc 3 millivolts	Pin 8 V102	2. Rotate the SWEEP WIDTH LIMIT control until the pip appears at the extreme left calibration line (-1000) of the crt screen.
29.0 Mc 3 millivolts	Pin 8 V102	3. Tune Z101 until the pip appears at the extreme right calibration line (+1000) of the crt screen.

continued overleaf

Oscillator Alignment continued

Set the Signal Generator Output To:	Feed the Signal To:	Procedure
30.0 Mc 3 millivolts	Pin 8 V102	4. Adjust the CF PAD so that the pip appears in the center of the crt screen. For accurate tip centering, broaden the tip by turning the SWEEP WIDTH FACTOR control counterclockwise, keeping the pip centered by adjusting the CF PAD. Return the SWEEP WIDTH FACTOR control to maximum clockwise position. Rotate the HORIZONTAL POSITION control until the pip is centered. 5. Repeat steps 1-4 until the pips fall into their proper positions. NOTE: Upon completion of the oscillator alignment, repeat step 1. The pip should be approximately three screen calibration lines high. Adjust the IF PAD for a pip height of two divisions.

NOTE

If it is not possible to set the 31.0 mc pip to within ±1/2 division of the extreme left crt screen calibration line and have the center and low frequency pips correctly placed on the screen, it will become necessary to change the value of resistor R163 (nominal value - 120 K ohms). If the 31.0 mc pip is outside the screen limits, decrease the value of R163. Use 15 K ohm decrements until a value of R163 is obtained which permits successful oscillator alignment.

Upon completion of the oscillator alignment, set the SWEEP WIDTH LIMIT control and the SWEEP WIDTH FACTOR control for maximum scanning width. The scanning width should not exceed 2400 kc (i.e., the reserve scanning width provided by the SWEEP WIDTH LIMIT control should not exceed ±200 kc.) If the scanning width is greater than 2400 kc., increase the value of R163 until the scanning width is 2400 kc. Then reset the SWEEP WIDTH LIMIT control for a 2000 kc. scanning width.

d. R-F Alignment

Set the Signal Generator Output To	Feed the Signal To:	Procedure
30.0 Mc 5 millivolts	Pin 8 V101 (6AC7)	1. Set the SWEEP WIDTH FACTOR and GAIN controls fully clockwise. 2. Turn the top core of T102 Fully counterclockwise. 3. Tune the top core of T102 for maximum pip height. Note that there are two positions of the core that yield a maximum. The correct one is the one nearer the full counterclockwise position.
31.0 Mc	Pin 4 V101	4. Tune the bottom core of T102 for a maximum pip on the crt screen.
29.0 Mc	Pin 4 V101	5. Adjust the overcoupling trimmer capacitor (located on top of T102) for a maximum pip height.

Set the Signal Generator Output To:	Feed the Signal To:	Procedure
30.0 Mc	Input	6. Adjust top and bottom cores of T101 for maximum pip height. Repeat R-F alignment procedure until peak deflections and frequency separations are correct.

b. Standard Sensitivity.

With the GAIN control set fully clockwise, feed a signal of 10 microvolts at a frequency of 30.0 mc to the input connector. Adjust the I.F. PAD for a 1/4 inch pip deflection. This may necessitate a "touch-up" alignment of the i-f section, which in turn will affect the standard sensitivity. Repeat until both standard sensitivity and proper i-f alignment are achieved.

V-7. LIST OF REPLACEABLE PARTS

The following is a list of the replaceable parts used in the Panadaptor, Model SA-3, T-2000NC.

In cases where an item appears more than once, total quantity in the equipment is listed the first time the item appears.

A legend of code letters used to designate manufacturers is given at the end of the list.

Values and ratings of components are nominal, and variations may exist in some equipments. In cases where variations exist, use the exact replacement of component found in the equipment.

When ordering parts from the factory, always include the following information:

Instrument Model Number
Instrument Serial Number
Panoramic Part Number
Part Description

LIST OF REPLACEABLE PARTS FOR MODEL SA-3, TYPE T-2000NC

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set
C1		CAPACITOR: fixed, silver mica, 470 uuf, ±5% Pan Part CM20-471J	AF CM20C471J	5
C2		CAPACITOR: fixed, silver mica, 470 uuf, ±5% Pan Part CM20-471J	AF CM20C471J	
C3		CAPACITOR: fixed, silver mica, 470 uuf, ±5% Pan Part CM20-471J	AF CM20C471J	
C101 A,B,C		CAPACITOR: fixed, paper, oil-filled, 3 x .1 uf, 600 V Pan Part CP55B5XF104X	AG BT-7511B-Y	5
C102 A,B,C		CAPACITOR: fixed, paper, oil-filled, 3 x .1 uf, 600 V Pan Part CP55B5XF104X	AG BT-7511B-Y	
C103 A,B,C		CAPACITOR: fixed, paper, oil-filled, 3 x .1 uf, 600 V Pan Part CP55B5XF104X	AG BT-7511B-Y	

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set
C104		Not Used.		
C105		CAPACITOR: fixed, silver mica, 470 uuf, ±5% Pan Part CM20-471J	AF CM20C471J	
C106		CAPACITOR: fixed, paper, oil-filled, 4 uf, 600 V Pan Part CP40C2XF405K-5	AG 8351	4
C107		CAPACITOR: fixed, silver mica, 270 uuf, ±5% Pan Part CM20-271J	AF CM20-271J	2
C108 A,B,C		CAPACITOR: fixed, paper, oil-filled, 3 x .1 uf, 600 V Pan Part CP55B5XF104X	AG BT-7511B-Y	
C109		CAPACITOR: fixed, silver mica, 270 uuf, ±5% Pan Part CM20-271J	AF CM20-271J	
C110		CAPACITOR: fixed, silver mica, 120 uuf, ±5% Pan Part CM20-121J	AF CM20C121J	1
C111 A,B,C		CAPACITOR: fixed, paper, oil-filled, 3 x .1 uf, 600 V Pan Part CP55B5XF104X	AG BT-7511B-Y	
C112		CAPACITOR: fixed, paper, oil-filled, 4 uf, 600 V Pan Part CP40C2XF405K-5	AG 8351	
C113		CAPACITOR: fixed, paper, oil-filled, 4 uf, 600 V Pan Part CP40C2XF405K-5	AG 8351	
C114		CAPACITOR: fixed, paper, oil-filled, 4 uf, 600 V Pan Part CP40C2XF405K-5	AG 8351	
C115		CAPACITOR: fixed, paper, oil-filled, .25 uf, 1500 V Pan Part CP40C2XH254K-5	AG 8378	2
C116		CAPACITOR: fixed, paper, oil-filled, .25 uf, 1500 V Pan Part CP40C2XH254K-5	AG 8378	
C118		Not Used.		
C119		Not Used.		
C120		Not Used.		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set
C121		CAPACITOR: fixed, silver mica, 100 uuf, ±5% Pan Part CM20-101J	AF CM20C101J	2
C122		CAPACITOR: fixed, silver mica, 470 uuf, ±5% Pan Part CM20-471J	AF CM20C471J	
C123		CAPACITOR: fixed, silver mica, 100 uuf, ±5% Pan Part CM20C101J	AF CM20C101J	
C124		CAPACITOR: fixed, foil mica, .01 uf, ±10% Pan Part CM35B103K	AF CM35B103K	1
C125		CAPACITOR: fixed, paper, oil-filled, .25 uf, 600 V Pan Part CP55B1EF254X-5	AG BT-7502B-Y	1
C126		CAPACITOR: fixed, paper, oil-filled, .5 uf, 600 V Pan Part CP51B1XF504V-1	AJ PBTT-545	1
C127		CAPACITOR: fixed, silver mica, 470 uuf, ±5% Pan Part CM20-471J	AF CM20-471J	1
C132		CAPACITOR: fixed, ceramic disc, .01 uf, 500 V Pan Part CC2003-17	AA 36-103W	1
F101		CARTRIDGE FUSE: 1-1/4" lg. 1/4" dia, 2 amps, 250 V Pan Part F1003	AC AGC-2	1
I101		PILOT LAMP: #47 Pan Part B1007	AE #47	1
L101 A,B		FILTER REACTOR: dual, 11 hys per section Pan Part L3-11361A	AH L3-11361A	1
L102		CHOKE: r-f, 100 uh Pan Part L1112	AL CH-3-3	1
L103		CHOKE: r-f, 0.56 uh Pan Part L2004	AM CLA-.56	1
R1		RESISTOR: fixed, composition, 51 ohms, ±5%, 1/2 W Pan Part RC20BX510J	AA EB5105	1
R2		RESISTOR: fixed, composition, 180 ohms, ±5%, 1/2 W Pan Part RC20BX181J	AA EB1815	1
R3		RESISTOR: fixed, composition, 18 ohms, ±5%, 1/2 W Pan Part RC20BX180J	AA EB1805	1

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set
R4		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1 W Pan Part RC32BX473J	AA GB4735	2
R5		RESISTOR: fixed, composition, 3000 ohms, ±5%, 1 W Pan Part RC32BX302J	AA GB3025	
R6		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W Pan Part RC20BX103J	AA EB1035	1
R101		RESISTOR: variable, composition, CCW taper, 5000 ohms, ±10%, 2 W Pan Part RV010	AA RV4NAYSD502E	1
R102		RESISTOR: fixed, composition, 510 ohms, ±5%, 1/2 W Pan Part RC20BX511J	AA EB5115	2
R103		RESISTOR: fixed, composition, 33 ohms, ±5%, 1/2 W Pan Part RC20BX330J	AA EB3305	1
R104		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1 W Pan Part RC32BX473J	AA GB4735	
R105		RESISTOR: fixed, composition, 24,000 ohms, ±5%, 2 W Pan Part RC42BX243J	AA HB2435	2
R106		RESISTOR: fixed, composition, 2200 ohms, ±5%, 1 W Pan Part RC32BX222J	AA GB2225	2
R109		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1/2 W Pan Part RC20BX473J	AA EB4735	1
R111		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1 W Pan Part RC32BX222J	AA GB2225	
R112		RESISTOR: fixed, composition, 150 ohms, ±5%, 1/2 W Pan Part RC20BX151J	AA EB1515	1
R115		RESISTOR: variable, composition, linear, 100,000 ohms, ±10%, 2 W Pan Part RVA104AQ-2J	AA RV4NAYSD104A	1
R116		RESISTOR: fixed, composition, 24,000 ohms, ±5%, 2 W Pan Part RC42BX243J	AA HB2435	
R118		RESISTOR: fixed, composition, 5100 ohms, ±5%, 1 W Pan Part RC32BX521J	AA GB5125	1
R119		RESISTOR: fixed, composition, 150,000 ohms, ±5%, 1/2 W Pan Part RC20BX154J	AA EB1545	1

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set
R120		RESISTOR: fixed, composition, 27,000 ohms, ±5%, 1 W Pan Part RC32BX273J	AA GB2735	1
R121		RESISTOR: fixed, wire-wound, 5,000 ohms, 20 W Pan Part RW20X502R-4	AM 20F	1
R124		RESISTOR: fixed, composition, 1,500 ohms, ±5%, 1/2 W Pan Part RC20BX152J	AA EB1525	1
R125		RESISTOR: fixed, composition, 2,000 ohms, ±5%, 1/2 W Pan Part RC20BX202J	AA EB2025	1
R126		RESISTOR: fixed, composition, 2 meg, ±5%, 1/2 W Pan Part RC20BX205J	AA EB2055	3
R127		RESISTOR: fixed, composition, 240,000 ohms, ±5%, 1 W Pan Part RC32BX244J	AA GB2445	2
R129		RESISTOR: fixed, composition, 510 ohms, ±5%, 1/2 W Pan Part RC20BX511J	AA EB5115	
R130		RESISTOR: fixed, composition, 220 ohms, ±5%, 1/2 W Pan Part RC20BX221J	AA EB2215	2
R131		RESISTOR: fixed, composition, 510,000 ohms, ±5%, 1/2 W Pan Part RC20BX514J	AA EB5145	1
R132		RESISTOR: variable, composition, linear, 1 meg, ±20%, 2 W Pan Part RV002	AA RV4NAYSD105B	1
R133		RESISTOR: fixed, composition, 5100 ohms, ±5%, 1/2 W Pan Part RC20BX512J	AA EB5125	1
R134		RESISTOR: fixed, composition, 33,000 ohms, ±5%, 1/2 W Pan Part RC20BX333J	AA EB3335	1
R135		RESISTOR: variable, composition, linear, 2 meg, ±20%, 2 W Pan Part RV017	AA RV4NAYSD205B	1
R136		RESISTOR: variable, composition, linear, 250,000 ohms, ±10%, 2 W Pan Part RV024	AA RV4NAYSD254A	3
R137		RESISTOR: variable, composition, linear, 250,000 ohms, ±10%, 2 W Pan Part RV024	AA RV4NAYSD254A	

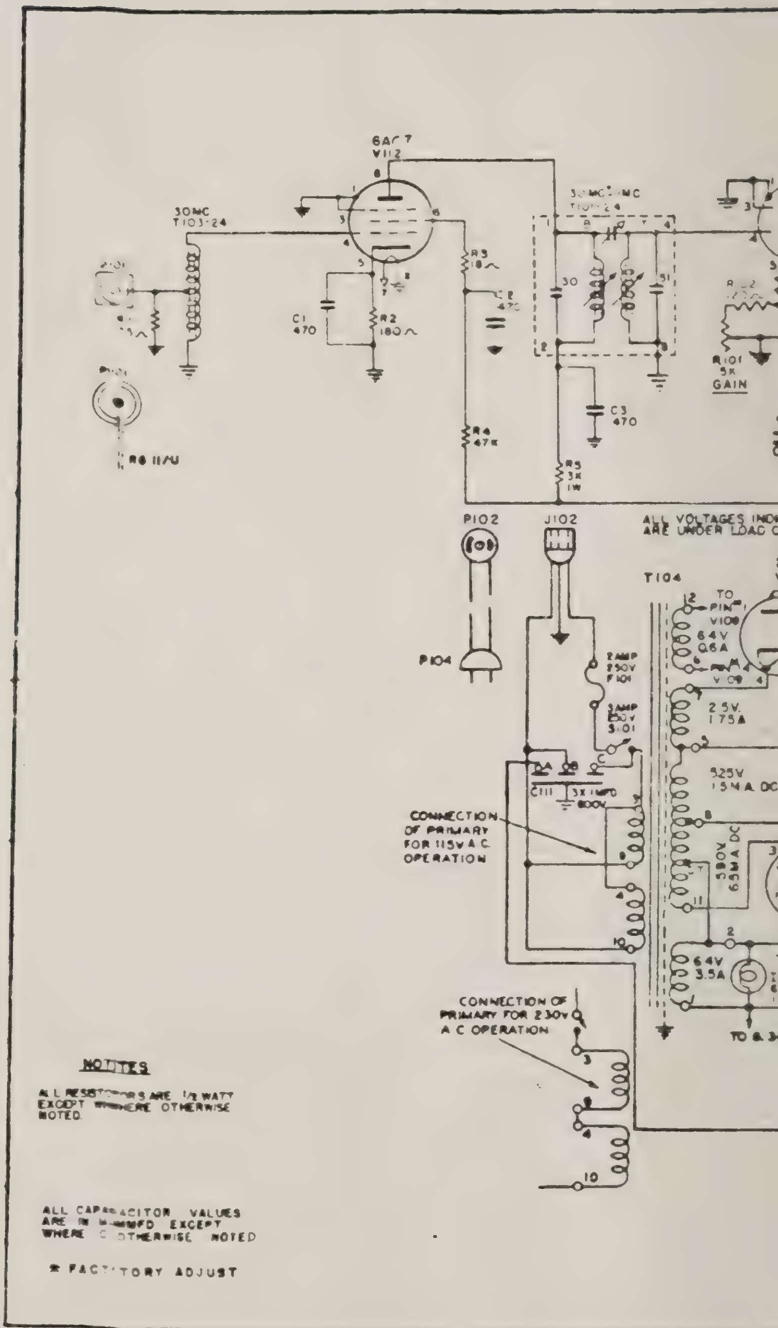
Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set
R138		RESISTOR: fixed, composition, 22,000 ohms, ±5%, 1/2 W Pan Part RC20BX223J	AA EB2235	1
R139		RESISTOR: variable, composition, linear, 2000 ohms, ±10%, 2 W Pan Part RV040	AA JA4N056S202UA	1
R140		RESISTOR: fixed, composition, 1000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AA EB1025	1
R141		RESISTOR: fixed, composition, 220 ohms, ±5%, 1/2 W Pan Part RC20BX221J	AA EB2215	
R142		RESISTOR: variable, composition, linear, 500 ohms, ±10%, 2 W Pan Part RV009	AA RV4NAYSD501A	1
R143		RESISTOR: variable, composition, linear, 500,000 ohms, ±5%, 2 W Pan Part RV015	AA RV4NAYSD504A	2
R144		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AA GB1045	2
R145		RESISTOR: fixed, composition, 150,000 ohms, ±5%, 1 W Pan Part RC32BX154J	AA GB1545	2
R146		RESISTOR: fixed, composition, 240,000 ohms, ±5%, 1 W Pan Part RC32BX244J	AA GB2445	
R147		RESISTOR: variable, composition, linear, 500,000 ohms, ±10%, 2 W Pan Part RV015	AA RV4NAYSD504A	
R148		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AA GB1045	
R149		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045	2
R150		RESISTOR: fixed, composition, 5600 ohms, ±5%, 1/2 W Pan Part RC20BX562J	AA EB5625	1
R151		RESISTOR: fixed, composition, 2 meg, ±5%, 1/2 W Pan Part RC20BX205J	AA EB2055	
R152		RESISTOR: fixed, composition, 3000 ohms, ±5%, 1/2 W Pan Part RC20BX302J	AA EB3025	1

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set
R153		RESISTOR: fixed, composition, 75,000 ohms, ±5%, 1/2 W Pan Part RC20BX753J	AA EB7535	1
R154		RESISTOR: fixed, composition, 2 meg, ±5%, 1/2 W Pan Part RC20BX205J	AA EB2055	
R155		RESISTOR: fixed, composition, 150,000 ohms, ±5%, 1 W Pan Part RC32BX154J	AA GB1545	
R156		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045	
R157		RESISTOR: fixed, composition, 200,000 ohms, ±5%, 1/2 W Pan Part RC20BX204J	AA EB2045	1
R158		RESISTOR: fixed, composition, 2,000 ohms, ±5%, 1/2 W Pan Part RC20BX202J	AA EB2025	
R159		RESISTOR: fixed, composition, 470,000 ohms, ±5%, 1 W Pan Part RC32BX474J	AA GB4745	1
R160		RESISTOR: variable, composition, linear, 250,000 ohms, ±10%, 2 W Pan Part RV024	AA RV4NAYSD254A	
R161		RESISTOR: fixed, composition, 200,000 ohms, ±5%, 1 W Pan Part RC32BX204J	AA GB2045	1
R162		RESISTOR: variable, composition, linear, 50,000 ohms, ±10%, 2 W Pan Part RV014	AA RV4NAYSD503A	1
R163		RESISTOR: fixed, composition, 120,000 ohms, ±5%, 1/2 W Pan Part RC20BX124J	AA EB1245	1
R164		RESISTOR: fixed, composition, 51,000 ohms, ±5%, 1/2 W Pan Part RC20BX513J	AA EB5135	1
S101		SWITCH: toggle DPST, bat handle Pan Part S2021N	AB 810246GB	1
T1		AUTO TRANSFORMER: rf Pan Part ZN-8346	AH ZN-8346	1
T101		TRANSFORMER: rf, 30 mc Pan Part ZN-8354	AH ZN-8354	1

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set
T102		TRANSFORMER: rf, 30 mc Pan Part ZN-8345	AH ZN-8345	1
T103		TRANSFORMER: pulse Pan Part T2-10790A	AH T2-10790A	1
T104		TRANSFORMER: power Pan Part T3-12262A	AH T3-12262A	1
V101		ELECTRON TUBE: 6AC7 Pan Part 6AC7	AN 6AC7	3
V102		ELECTRON TUBE: 6U8 Pan Part 6SB7Y	AN 6SB7Y	1
V103		ELECTRON TUBE: 6SG7 Pan Part 6SG7	AN 6SG7	1
V104		ELECTRON TUBE: 6SQ7 Pan Part 6SQ7	AN 6SQ7	1
V105		ELECTRON TUBE: 2X2A Pan Part 2X2A	AN 2X2A	1
V106		ELECTRON TUBE: OC3/VR105 Pan Part OC3/VR105	AN OC3/VR105	1
V107		ELECTRON TUBE: 6AC7 Pan Part 6AC7	AN 6AC7	
V108		ELECTRON TUBE: 6SL7GT Pan Part 6SL7GT	AN 6SL7GT	2
V109		ELECTRON TUBE: cathode-ray, 3BP1A Pan Part 3BP1A	AN 3BP1A	1
V110		ELECTRON TUBE: 6X5-GT Pan Part 6X5-GT	AN 6X5-GT	1
V111		ELECTRON TUBE: 6SL7GT Pan Part 6SL7GT	AN 6SL7GT	
V112		ELECTRON TUBE: 6AC7 Pan Part 6AC7	AN 6AC7	
Z101		OSCILLATOR COIL: 26.5 mc Pan Part ZN-8349	AH ZN-8349	1
Z102		TRANSFORMER: rf, 3.5 mc Pan Part ZN-8293	AH ZN-8293	1
Z103		TRANSFORMER: rf, 3.5 mc Pan Part ZN-8294	AH ZN-8294	1

MANUFACTURERS CODE FOR LIST OF REPLACEABLE PARTS

AA	Allen Bradley Co.
AB	Arrow Hart and Hegeman Electric Co.
AC	Bussman Fuse, Div. of McGraw Edison Co.
AD	Centralab, Div. of Globe Union, Inc.
AE	Dialight Co. of America, Inc.
AF	Electro Motive Manufacturing Co.
AG	Gudeman Co.
AH	Panoramic Radio Products, Inc.
AJ	Sprague Electric Co.
AK	Stackpole Carbon Co.
AL	Teleradio Engineering Corp.
AM	Ward Leonard Electric Co.
AN	Any EIA Tube Manufacturer
AM	Internation Resistance Company



6AC7
V112
30MC
T103-24
R2
180
C1
470
R3
R4
47K
R5
3K
1W
C3
470
R101
5K
GAIN
RG 11/U
P102
J102
P104
T104
2 AMP
250V
F101
C111
3X 1 MFD
600V
CONNECTION OF PRIMARY FOR 115V A.C. OPERATION
CONNECTION OF PRIMARY FOR 230V A.C. OPERATION
6.4V
0.6A
2.5V
1.75A
525V
6.4V
3.5A
ALL VOLTAGES INDI
ARE UNDER LOAD C
NOTES
ALL RESISTORS ARE 1/2 WATT EXCEPT WHERE OTHERWISE NOTED.
ALL CAPACITOR VALUES ARE IN MMFD EXCEPT WHERE OTHERWISE NOTED
* FACTORY ADJUST

ALL RESISTOR
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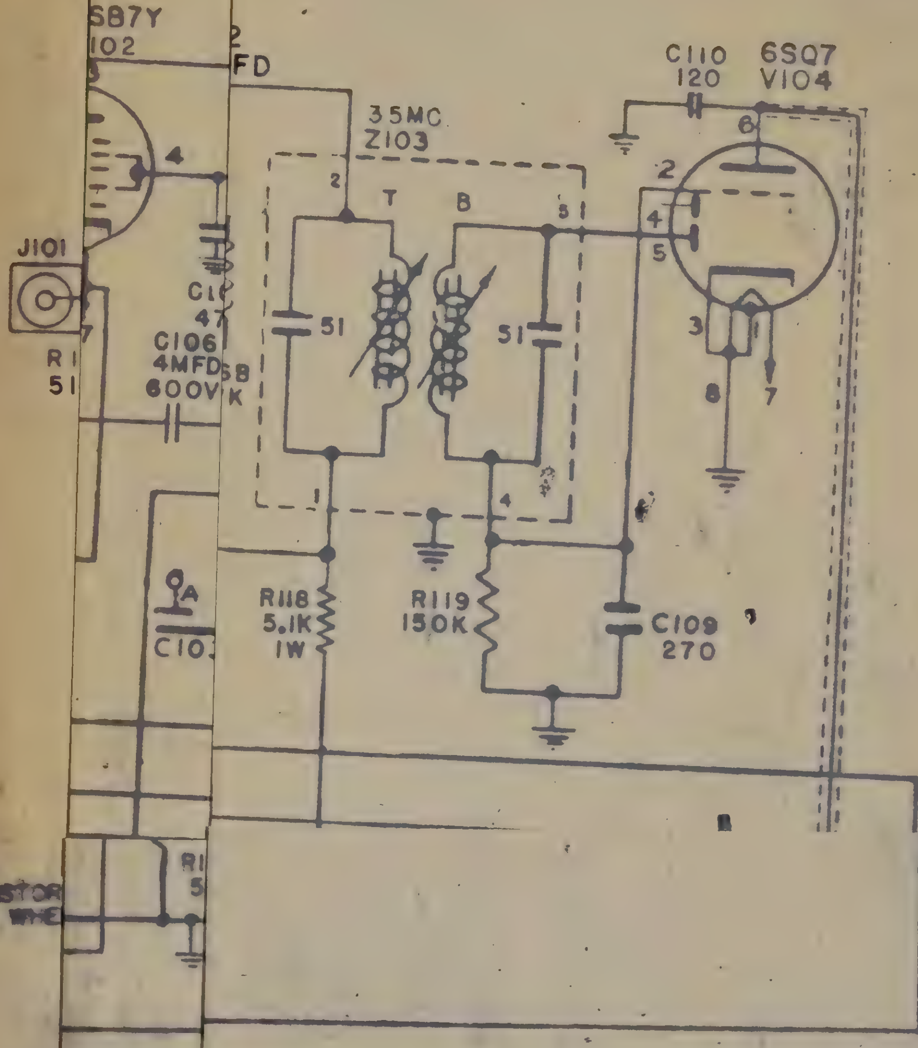

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10/60
CHANGES

DRAFTSMAN		J.S.	9-20-56
CHECKER		F.B.	9-20-56
ORIGINATOR		OJ	9-20-56
APP.	ELECT	—	
	SPEC.	—	
	ENG.		9/20/56

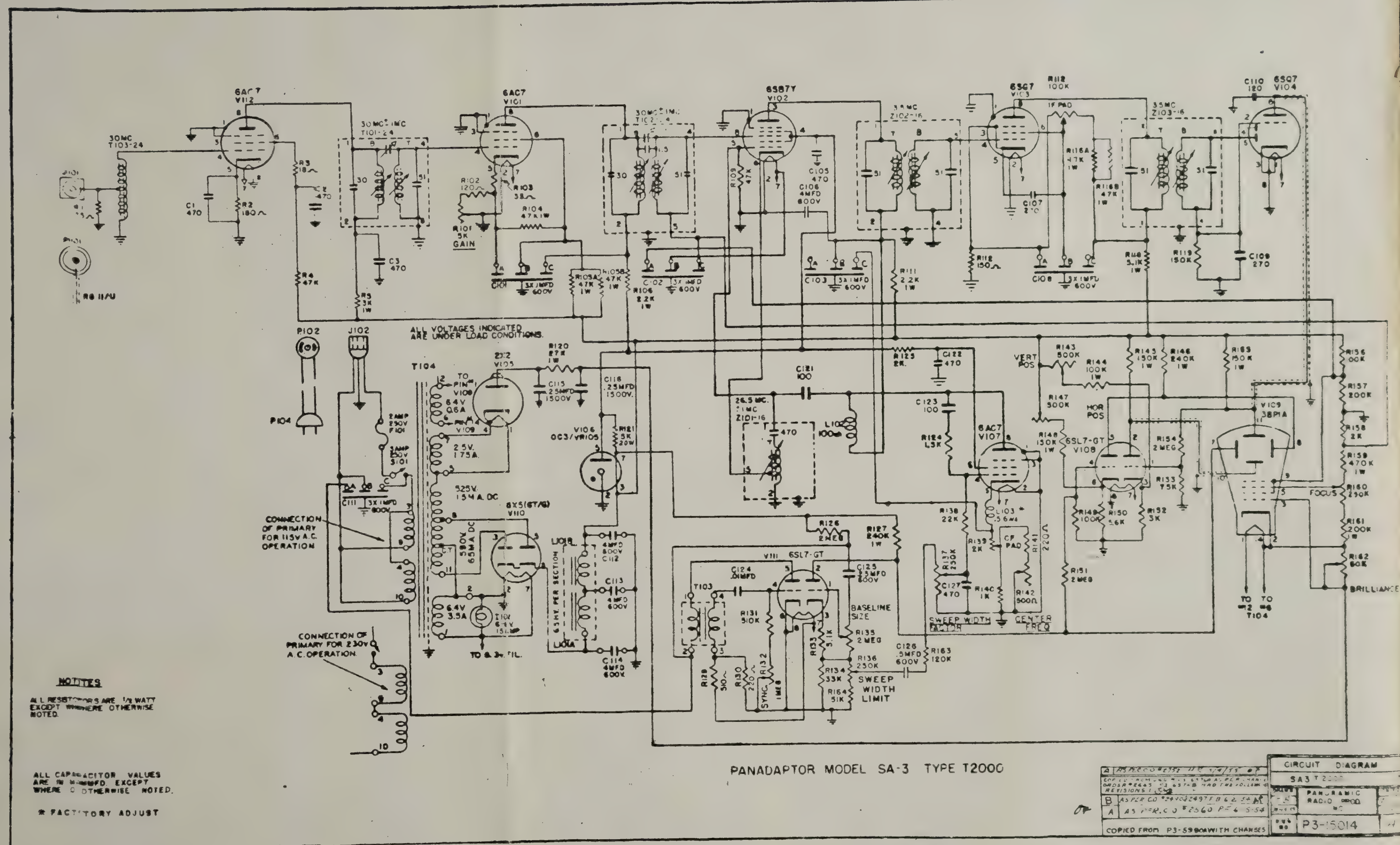
CIRCUIT DIAGRAM

SA3 T 2000 NC

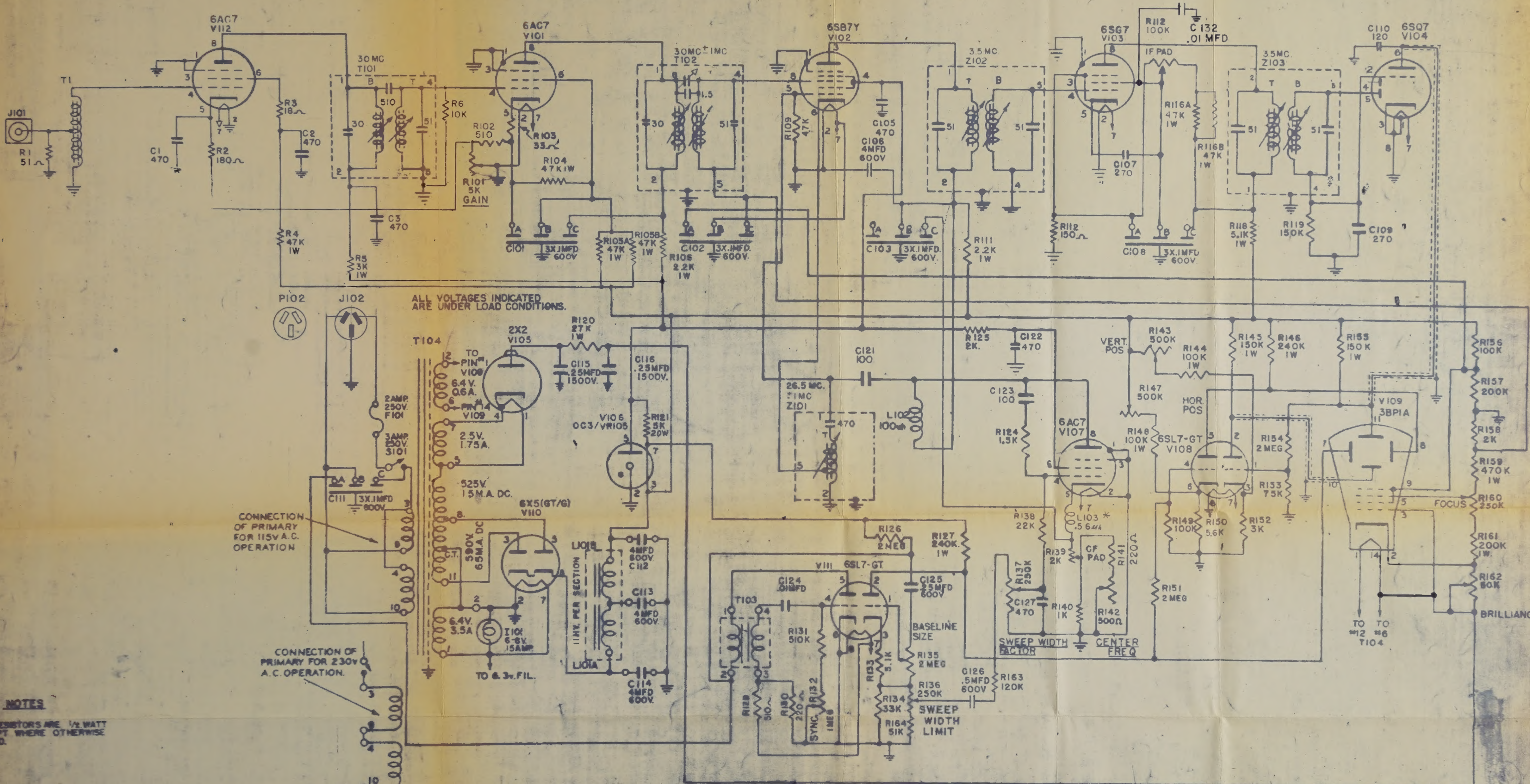
THE SINGER COMPANY
METRICS DIVISION
BRIDGE CRT CONN. U.S.A.

DWG. NO. 556155-124 02

REF P3-15124



ALL VOLTAGES INDICATED ARE UNDER LOAD CONDITIONS.
CONNECTION OF PRIMARY FOR 115V A.C. OPERATION
CONNECTION OF PRIMARY FOR 230V A.C. OPERATION
NOTES
ALL RESISTORS ARE 1/2 WATT EXCEPT WHERE OTHERWISE NOTED.
ALL CAPACITOR VALUES ARE IN MMFD. EXCEPT WHERE OTHERWISE NOTED.
* FACTORY ADJUST
PANADAPTOR MODEL SA-3 TYPE T2000
CIRCUIT DIAGRAM
SA3 T2000
PANORAMIC RADIO
COPIED FROM P3-5990 WITH CHANGES
P3-15014



NOTES

ALL RESISTORS ARE 1/2 WATT EXCEPT WHERE OTHERWISE NOTED.

ALL CAPACITOR VALUES ARE IN MMFD. EXCEPT WHERE OTHERWISE NOTED.

* FACTORY ADJUST

PANADAPTOR MODEL SA-3 TYPE T2000 NC

DRAFTSMAN	J.S.	9-20-56
CHECKER	F.B.	9-20-56
ORIGINATOR		9-20-56
APP. ELECT	—	
SPEC.	—	
ENG.		

02 CHG PER PCN #1479 June 20, 64

AS PER CO-4358 IPH. 5/10/60

Copied From P3-15014C With Changes

CIRCUIT DIAGRAM

SA3 T2000 NC

THE SINGER COMPANY METRICS DIVISION BRIDGEPORT CONN. U.S.A.

DWG. NO. 556155-124 02

REF P3-15124